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CARTWRIGHT (W. B.) & NOBLE (W. B.). **Studies on biological Races of the Hessian Fly.**—*J. agric. Res.* **75** no. 4 pp. 147–153, 1 fig., 7 refs. Washington, D.C., 1947.

The following is substantially the authors' summary. Tests at La Fayette, Indiana, since 1935 have substantiated the existence of different biological races of *Mayetiola* (*Phytophaga*) *destructor*, Say, in California and Indiana such as those indicated in previous studies [*cf. R.A.E.*, A **20** 43, etc.]. The characteristics of the two populations as noted in field trials in the two regions were maintained when tested on resistant and susceptible wheats in the greenhouse at La Fayette. Some varieties that were resistant to the California populations were susceptible to the Indiana population.

In studies on host-restricted races of the fly, a population that was bred from the general population at La Fayette and proved capable of heavily infesting many resistant common wheats, was bred and tested for six generations on resistant wheats. The percentage of plants stunted or susceptible in the resistant varieties was doubled after breeding the population through the third to sixth generations, but it did not attain the 100 per cent. injury of susceptible wheats.

The selected population was cultured for more extensive tests on resistant wheats, and the differences in infestations obtained in certain varieties indicated the probability of further segregation of this population. Several durum wheats that appeared to be immune from the general population were uninfested by the selected population.

The results indicate that a fully effective programme for breeding resistance to the fly must provide for the possible appearance of biological races within regions, as well as for their known presence in different regions, through a study of the genetic diversity of fly populations, as well as a study of the genetically different factors for fly-resistance in different varieties of wheat.

Studies on the Control of Wheat Insects by Dust.—*Bull. Coun. sci. industr. Res. Aust.* no. 225, 38 pp., 5 figs., 16 refs. Melbourne, 1947.

This bulletin contains four papers, abstracts of which appear below.

GAY (F. J.), RATCLIFFE (F. N.) & MCCULLOCH (R. N.). **Field Tests of various Mineral Dusts against Grain Weevils,** pp. 7–20, 1 fig., 2 refs. The results are given of tests made under conditions more closely approximating to those of actual storage, of inert mineral dusts that had given promising results in the protection of stored wheat against insect pests under laboratory conditions [*cf. R.A.E.*, A **33** 372]. The tests were carried out at Toowoomba, southern Queensland, where stored wheat normally has a high moisture content (12–14 per cent.) and a favourable climate results in the occurrence of very high insect populations, and at Seven Hills, New South Wales, where the climate is reasonably typical of wheat storage sites adjacent to ports in southern Australia. The dusts used were Neosyl (very finely divided silica), a magnesite from Weedalion, New South Wales, dolomite, limonite, hydrated lime and copper oxychloride, which has apparently not previously been tested for insecticidal properties.

At Toowoomba, 0·4 per cent. Neosyl and 0·4 or 0·8 per cent. dolomite or magnesite by weight were mixed with the wheat in three-bushel bags and a small amount of wheat infested by *Calandra oryzae*, L. (large strain [**34** 21]) was put on top of the wheat in each bag before it was sewn up. The treated bags and controls were stacked side by side in a shed used for storing infested wheat and were therefore liable to substantial additional infestation. The

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test was begun on 10th January 1941, and some of the bags were examined on 11th August. The numbers of weevils and the percentages of bored grains found did not differ much for the various dusts, but the general condition of the wheat indicated that magnesite was the most effective. The weevils had wandered freely through the untreated bag, whereas they were practically confined to the top layer in the treated ones, and the mean weight of the controls was 22 per cent. less than that of the treated bags. By the end of August, the contents of the other untreated bags had been virtually destroyed. The remaining treated ones were examined in January 1942, when Neosyl proved slightly inferior to dolomite and magnesite, though no other outstanding differences between treatments were evident, partly owing to the development of an infestation of *Rhizopertha dominica*, F., which is less susceptible to mineral dusts than *Calandra*. The infestation was equivalent to a total of about a quarter of a million insects per bag, and the grain was classed as fit for milling.

At Seven Hills, 40 samples of 50 lb. wheat that had been conditioned to ensure uniform humidity were mixed with 0·5 per cent. Neosyl, hydrated lime, dolomite or limonite, 0·5 or 1 per cent. magnesite or 0·2 per cent. copper oxychloride, transferred to sugar bags, and infested with *C. oryzae* and *C. granaria*, L., the inoculum consisting of 200 adults and 40 gm. wheat containing all immature stages, which is considered equivalent to 2,000 or more live weevils. The inoculum was put on the wheat at the top of the bag, which was tied up and inverted on a wooden plate on the concrete floor, so that the focus of infestation was against the floor. Strips of sacking soaked in crude oil were laid on the floor between the bags to reduce infestation by migrating weevils, and fresh oil was added periodically during the 18 months of the test. Examination after 12 months showed a marked difference in the protective value of the dusts, the order of decreasing efficiency being 0·5 per cent. magnesite, 1 per cent. magnesite, Neosyl, dolomite, copper oxychloride, limonite and hydrated lime. There was little if any increase of the initial population in some of the bags, including those treated with magnesite, but limonite and hydrated lime had permitted the development of a population that approached or exceeded that in untreated bags. The weights per bushel of grain ranged from 56·25 to 58·25 lb. for magnesite, Neosyl, dolomite and copper oxychloride and from 53 to 55 lb. for limonite and hydrated lime, and were below 50 lb. in two of the three untreated bags. After a further six months, copper oxychloride had given most protection, but the order of efficiency of the other materials was unaltered. When the two sets of results were considered, copper oxychloride was found inferior to magnesite, but superior to any of the other dusts. The weights per bushel after 18 months were 53·5–58·25 lb. for the effective materials, 38–48 lb. for limonite and hydrated lime and 38·25–39·25 for no treatment. The temperature of the wheat was about 58–59°F. in dusted bags and 63°F. in undusted ones four months after the experiment began, 79–82° in bags treated with effective dusts and 89–92° in untreated ones and those treated with ineffective materials after a year, and 53–54·5° in bags treated with effective dusts and 57–62° in the others after 18 months.

Gay (F. J.). **Further Tests of various Mineral Dusts for the Control of Grain Pests,** pp. 21–28, 7 refs. The 70 inert mineral dusts used in the laboratory tests described included some that had already been tested [**33** 372], some of similar type to the more effective of these but from different sources in Australia, new local materials, including certain industrial residues, and proprietary dusts from overseas. The insects used were *Calandra oryzae* (large strain) and *Rhizopertha dominica*, and they were reared and tested at 26°C. [78·8°F.] and 32°C. [89·6°F.], respectively, the temperature being near the optimum for the species in each case. All dust samples were passed

through a 200-mesh sieve, mixed with 35 gm. wheat and tested against both insects at relative humidities of 45 and 65 per cent. and at rates of 1 and 0·5 per cent. by weight. Mortalities were recorded at intervals for up to 14 days after treatment except in the tests against *R. dominica* at 65 per cent. relative humidity, in which the period was extended for up to 40 days because of the slower action of the dusts on that insect at that humidity. The mean mortality percentages were plotted against time, and the times to the nearest half-day for 50 and 90 per cent. mortality obtained from the resulting graphs. The outstanding result was the superiority at both mortality levels of two proprietary alumina [aluminium-oxide] dusts, Almicide and Alkalox, and of Neosyl, a form of finely divided silica, which was only slightly inferior to them. The alumina dusts were the only ones that consistently killed *R. dominica* more rapidly than *C. oryzae*. Both were as effective at the lower as at the higher rate, which, coupled with their low bulk-density, suggested that a further reduction could be made without materially lowering their efficiency. When Almicide was tested against both insects at 45 per cent. relative humidity and a rate of 0·25 per cent., there was no lowering of its speed of action or efficiency. Magnesite was the most effective Australian material, deposits in Victoria, South Australia and Western Australia yielding dusts better than any but the three already mentioned, but there was considerable variability of magnesite both within a deposit and between deposits, possible reasons for which are discussed. The six industrial residues were almost the poorest materials tested and showed no promise. Although certain other dusts such as diatomite and halloysite were comparable in efficiency with magnesite, factors such as colour, the danger of silicosis or the smallness of the deposit might make them less suitable for commercial use.

Gay (F. J.). **The Use of Dust Barriers for the Control of Grain Insects,** pp. 29–32, 1 ref. The author describes experiments to determine whether a barrier consisting of a continuous strip of dust round the base of an isolated stack of bulk or bagged grain could be used to trap beetles attempting to invade it. The dusts tested were dolomite from Victoria and magnesite from New South Wales. Adults of *Calandra oryzae* (large and small strains) and *C. granaria* reared at 26°C. and of *Rhizopertha dominica*, *Tribolium castaneum*, Hbst., *T. confusum*, Duv., *Oryzaephilus surinamensis*, L., *Laemophloeus minutus*, Ol., and *Latheticus oryzae*, Waterh., reared at 32°C. were used, and tests were made at temperatures of 26 and 32°C. and 45 and 65 per cent. relative humidity. For each test the dust was spread in a circular band 12 ins. wide and $\frac{1}{4}$–$\frac{1}{2}$ in. deep round a central clear space 3 ins. in diameter and either left smooth or raked to produce concentric furrows ; 50 test insects that had been conditioned to the temperature and humidity of the test were liberated in the central space and observed during the ensuing 6–8 hours, most of those that were able to cross the barriers doing so in this period. Any insects that crossed the barrier were transferred to clean food material and retained for a week to ascertain the effect of contact, and the remaining insects were removed after 24 hours, since it was found that those that had not crossed by that time could not do so subsequently. The insects that failed to cross were either dead, moribund or seriously affected by the dust at the end of the test period, whereas many of those that crossed survived for at least a week and oviposited. The species varied considerably in their ability to cross the barriers, and in general more insects crossed a particular type of dust barrier at the higher than at the lower humidity. An increase in temperature from 26 to 32°C. did not have any consistent effect on the numbers crossing. Magnesite was consistently superior to dolomite, frequently giving complete protection, and in all tests, raked barriers were more effective than smooth ones. Since the time that a barrier will remain effective without attention is important in commercial practice, a raked magnesite barrier was

prepared and kept at 32°C. and 65 per cent. relative humidity for one week, after which 50 adults of *C. oryzae* (large strain), *T. castaneum.* and *O. surinamensis* were liberated in the central space. None crossed the barrier during the 24 hours of the test, and 100, 96 and 90 per cent., respectively, were dead when removed from the dust. When a similar barrier was kept out of doors and protected from the rain but otherwise subject to air movement and to fluctuations in temperature and relative humidity for a week before adults of the three species were liberated in the central space, no insects crossed and 100, 90 and 92 per cent. were dead when removed from the dust 24 hours later. A raked magnesite barrier is thus as efficient after a week as when freshly laid down, and it is concluded that barriers of this type should be of value in protecting isolated stocks of grain in buildings.

Gay (F. J.). **The Use of DDT- and 666-impregnated Dusts for the Control of Grain Pests,** pp. 33–38, 4 figs., 10 refs. Since DDT and benzene hexachloride (666) have given promising results against insects attacking stored products, tests were made of their effectiveness against the two most important pests of stored grain in Australia, *Rhizopertha dominica* and *Calandra oryzae*, when applied as dusts to wheat stored in bulk. Dusts of pyrophyllite impregnated with pure DDT, BHC (crude benzene hexachloride containing 13 per cent. γ isomer) and γ BHC (pure γ benzene hexachloride) at concentrations of 1 : 1,000, 1 : 5,000, 1 : 10,000, 1 : 25,000 and 1 : 50,000, and of magnesite, the most effective abrasive dust of Australian origin, impregnated with γ BHC at concentrations of 1 : 5,000, 1 : 10,000, 1 : 25,000, 1 : 50,000 and 1 : 75,000 were tested in 35 gm. wheat at rates of 1 and 0·5 per cent. by weight against adults of *C. oryzae* (small strain) at 26°C. and of *R. dominica* at 32°C., all at a relative humidity of 65 per cent. Mortality counts were made at intervals for 14 days, and the mean percentages were plotted against time. The graphs for the pyrophyllite dusts showed that γ BHC was the most effective of the three materials and that *R. dominica* was more resistant than *C. oryzae* to all of them ; *C. oryzae* was more and *R. dominica* less resistant to BHC than to DDT. When the dusts were used at a dosage of 1 per cent., a concentration of 1 part DDT in 2,500,000 of wheat produced 50 per cent. kill of *C. oryzae* in ten days, whereas 1 part DDT in 100,000 wheat did not give complete kill of *R. dominica* in 14 days, and γ BHC gave 50 per cent. kill of *C. oryzae* in slightly less than three days at a concentration of 1 : 5,000,000 and in just under six days at 1 : 10,000,000, and 50 per cent. kill of *R. dominica* in less than three days at 1 : 2,500,000 and in less than four days at 1 : 2,000,000. Solely on the basis of content of γ isomer, dusts prepared from the pure isomer should have been about seven times as effective as those prepared from the crude compound, but comparison of results showed that they were actually about ten times as effective ; the non-active isomers and impurities present in the crude material may have reduced the activity of the γ isomer. When used in magnesite at both rates of application of the latter, γ BHC gave complete kill of *C. oryzae* in four days at 1 part in 5,000,000 of wheat, whereas magnesite alone required eight days to produce the same effect. At 1 per cent. by weight of wheat, magnesite dust caused 50 per cent. kill of *R. dominica* in less than two days when it contained sufficient γ BHC to give a concentration of 1 : 7,500,000 in wheat and in ten days when it contained none, and at 0·5 per cent. it caused 50 per cent. kill in eight days with γ BHC to give a concentration of 1 : 15,000,000 in wheat and failed to cause 50 per cent. kill in 14 days without it.

It is concluded that an impregnated dust of γ BHC on magnesite (1 : 25,000) might prove valuable in preventing or eliminating insect damage in bulk-stored wheat. If the dust were applied at the rate of 1 per cent. by weight to the top six inches of wheat in the store, the actual concentration of γ isomer in that wheat would be 1 : 2,500,000, and because of the thorough mixing that

occurs when wheat is removed from these bulk stores, the final concentration would be of the order of 1 : 100,000,000, which would appear to involve no danger to health.

GUNN (D. L.) & others. **Locust Control by Aircraft in Tanganyika. An experimental Campaign with BHC (Benzene Hexachloride) and DNOC (Dinitro-ortho-cresol) Solutions against Adult Red Locust,** *Nomadacris septemfasciata* **(Serv.), in an Outbreak Area, the Rukwa Valley, from August to November, 1947.**—153 pp., 10 pls., 32 figs., 21 refs. London, Anti-Locust Res. Cent. ; Pretoria, Locust Contr. Res. Sect., Dep. Agric. S. Afr., 1948.

This work consists of eight chapters by different authors dealing with various aspects of an experimental campaign in which sprays were applied by aircraft against adults of *Nomadacris septemfasciata*, Serv., in the Rukwa Valley, Tanganyika, in 1947.

A general account of the campaign and a discussion of the results are given by D. L. GUNN (pp. 3–27), and the following is almost entirely taken from his summary. The campaign was begun in August and completed by early November. Conditions proved to be unfavourable at Tumba in the North Rukwa and favourable at Milepa in the Central Rukwa. The finding and delimitation of swarms in the latter area were much less difficult than in most types of country, wind direction was satisfactorily predictable and towards the end of the period, locust behaviour was unusually favourable, for the swarms became virtually stationary. Altogether 2,100 gals. of a solution containing 2 per cent. γ benzene hexachloride (BHC) in a mixture of 20 per cent. toluene and 80 per cent. furnace oil and 3,920 gals. of one consisting of 20 per cent. dinitro-ortho-cresol (DNC) in a mixture of two aromatic extracts of petroleum were used. The BHC was slow in killing locusts and it was subsequently found to have been sprayed from too low an altitude to give a uniform enough application. Consequently a satisfactory estimate of its efficacy cannot be given, though it is undoubtedly less toxic and more costly than DNC for use against locusts. When benzene hexachloride as a dispersible powder was applied in water from a greater height in a subsidiary test, most of the water evaporated before reaching the ground and the rest within 20 seconds. The technique of spraying the DNC solution and the solution itself were highly satisfactory ; it gave complete mortalities at slightly over 1 gal. per acre. Under equally favourable circumstances of weather, terrain, and behaviour but with certain mechanical improvements, it would probably give complete clearance at little more than $\frac{1}{2}$ gal. per acre. The costing of aircraft spraying operations is discussed in relation to both anti-locust strategy and alternative methods of suppressing an outbreak. Aircraft operations could be carried out at a cost per acre little greater than that of the insecticide, if they were sufficiently intensive and prolonged, but the total cost would then be considerable. There is a certain inherent inefficiency in aircraft spraying, in fitting the target area to the swarm area, so that either some uninfested ground is sprayed or some locusts are not. It is suggested that the best use could be made of aircraft if they could destroy swarms of locusts in flight, and that roosting locusts could be attacked more economically by machinery mounted on suitable trucks.

H. A. F. LEA (pp. 27–33) describes the topography, climate and vegetation of the area and discusses the behaviour of the locusts under natural conditions and when disturbed by spraying operations. The following is taken from his summary. The flatness of the plains and the patchiness of the vegetation at Milepa made a particularly favourable situation for spraying roosting locusts.

During the BHC spraying, the locusts were easily disturbed during delimitation and by low flying, so that the spraying was never completely effective and the exact effect could not be estimated. There was a change of behaviour at the time when DNC spraying started, so that delimitation could be done without the locusts leaving, and the higher flying did not disturb them. Assessment of the completeness of the destruction of the swarm was easy.

D. H. Botha (pp. 33–63) describes some 32 spraying operations, of which 16 were undertaken as separate experiments to obtain information on such points as general procedure, methods of delimitation and demarcation, the behaviour of the locusts during the operation, and the assessment of their density and mortality, and the rest formed an experimental campaign.

Estimates of mortality based on caged samples of the sprayed swarms gave excessively high values, and S. Callaway (pp. 64–81) describes and discusses the methods that were used in assessing the densities and numbers of living locusts for comparison with the densities and numbers of dead ones observed after spraying. These comprised a direct method involving counts of locusts on sample stems of *Aeschynomene* in a roosting area, of stems per clump and of clumps per acre ; a photographic method [*cf. R.A.E.*, A **37** 121] ; and one based on a comparison of the numbers of dead locusts on sample lines passing at right angles through a heavily sprayed strip (spray drenching method) [*cf. loc. cit.*]. The results obtained were in fairly close agreement, and indicated a density of about 30 locusts per sq. yd. Two methods of assessing mortality from counts of dead locusts along sample lines crossing the sprayed area are also described, together with one for making visual estimates of density of living locusts before and after spraying, which is of value when very large areas are involved.

In view of the disappointing results obtained with BHC, the relation of the amount of spray released and the height of the aircraft to the amount and distribution of the spray deposited on the ground and the extent to which the locusts were sheltered by grass were investigated, and this work is described by A. Immelman (pp. 82–93). Analysis of the deposits obtained on glass plates in trial runs at heights of 30 and 45 ft. showed that 86 and 67 per cent., respectively, of the spray released reached the ground within about 50 ft. on either side of the line of flight. In another trial, in which the aircraft flew at a height of 30 ft., 70 per cent. was recovered from open ground, 9·3 per cent. from ground under grass 5 ft. high and 28 per cent. from a level 2·5 ft. above ground in the grass.

J. Ward (pp. 94–126) gives an account of the spraying technique adopted in the trials with DNC and of the theoretical principles upon which they were based. Two types of Anson aircraft (IX and XIX) were used, and their spraying installations and weight-carrying performance are described. The following is almost entirely the author's summary. The rate of emission of the Anson XIX was proportional to the setting of the emission valve and was 2·2 gals. per second at maximum setting when the tank was full, falling to about 1 gal. per second when it was nearly empty. With a constant rate of emission, it would be possible to cover an area 50 per cent. greater with one aircraft load, at a given minimum dosage, without using complicated spraying tactics. The capacity of the tanks in the Anson XIXs is too small ; the aircraft could carry more insecticide when the weight of fuel required is small. A field trial was carried out to determine the drop-spectrum (frequency distribution of the drop sizes) and the percentage of sprayed liquid that can be recovered from the ground. The mass medium diameter was found to be 0·43 mm. The ground recovery was 69 per cent. From laboratory work and from assessment of deposit densities in the field, it was estimated that an expenditure of about 2½ gal. per acre of 20 per cent. DNC solution would be required to give a mortality of 99 per cent. In the field operations, mortalities of this order

were obtained with doses of about ½ gal. per acre. Reasons for the discrepancy are discussed. It was decided that a sufficiently even deposit over the sprayed area would be obtained when the swathe width was 88 yds. and the HU product (the product of aircraft height in ft. and wind speed in miles per hour) was 2,000. Radio altimeters in the aircraft and compasses and more sensitive speedometers in the vehicles that mark the end of the spraying runs are required to improve the speed and accuracy of the spraying operations. With these aids, a ground party of four Europeans is desirable to control the spraying. Methods of measuring the height of the spraying aircraft are discussed and results of measurements compared. It is shown that the pilot cannot control the spraying height of an aircraft fitted only with a barometric altimeter with sufficient accuracy without assistance from the ground, and that it is difficult for the ground party to give the information required with certainty and accuracy. It is proposed that a radio altimeter should be used if this method of spraying is used in the future. It is considered that the accuracy of tracking when the aircraft was guided in its spraying run by white smoke generators was sufficient. A method of compensating for variations in rate of emission by varying the swathe width is discussed, two trials with it are described, and the causes and effects of mistakes made are analysed. It is concluded that it is too inflexible for routine use and alternative methods are suggested. The assessment of density of spray deposit by visual comparison of stains with standards of known density is shown to be very unreliable.

S. Callaway (pp. 127–136) contributes an account of work on the biometrics of *N. septemfasciata* based on data from locusts collected during the campaign in the Rukwa Valley and at Namanyere and Mpui on the plateau to the west of it, material available at Pretoria and the literature. The following is based on his summary. The E/F ratio of locusts collected in the Rukwa Valley and at Namanyere was intermediate between those of locusts in phases *solitaria* and *gregaria* from the Pretoria collection and were clearly of phase *transiens*. The Namanyere specimens had a slightly but quite significantly higher E/F ratio than those from the Rukwa Valley. The Namanyere swarm had migrated out of the Rukwa Valley, it was continuing to migrate and it always roosted mainly in trees, whereas the Valley locusts did not move about much, even in September, and invariably roosted in grass and herbs (*Aeschynomene*) even when close to trees. A swarm at Mpui that had migrated out of the Valley was biometrically almost identical with locusts remaining in it. Sexual dimorphism as indicated by the ratio between the lengths of the elytra of females and males is shown to be correlated with the E/F ratio. The more biometrically gregarious the locusts are, the more similar the sexes are in size. In phase *solitaria*, the females are much larger than the males. The ratio between total length and length of elytron was estimated for 40 specimens from the Rukwa Valley. The females were 25 per cent. longer than the males and their elytra only 10 per cent. longer, but the difference between total length and elytron length was 75 per cent. greater in females than in males.

J. R. Clackson & J. J. Taljaard (pp. 137–152) present meteorological data obtained in the experimental area during the campaign and at three meteorological stations in the same region of Tanganyika over a number of years, and discuss them with reference to spraying technique. Temperature and humidity are not important in the spraying process but may affect the activity of the locusts and so, indirectly, the time available for spraying; no data on low temperatures or on dew were obtained. The speed and direction of the wind are the most important factors in spraying, and in the technique finally adopted the aircraft flew at right angles to the direction of the wind and at a height that depended on wind speed and was determined by assigning a constant value (2,000) to the HU product. This produced parallel and overlapping swathes of spray when the wind was steady.

Tothill (J. D.). Ed. **Agriculture in the Sudan.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xviii+974 pp., 408 figs. (incl. 52 pls.), 8 maps, 5 fldg. maps (2 col.), 1 fldg. map in pocket, 3 tables (2 fldg.), 22 pp. refs. London, Oxford Univ. Pr., 1948. Price 42*s*.

This handbook deals comprehensively with agriculture and the conditions under which it is practised in the Anglo-Egyptian Sudan. The organisation of agricultural research and the experimental farms are described by F. Crowther, who also gives a review of experimental work (pp. 439–592) including details of investigations on *Hercothrips* spp., *Dysdercus* spp., *Platyedra gossypiella*, Saund., and *Empoasca lybica*, Berg., on cotton, *Agonoscelis pubescens*, Thnb., on sorghum, and the leaf-curl disease of cotton, which is transmitted by *Bemisia tabaci*, Gennadius (*gossypiperda*, Misra & Lamba). A chapter by G. H. Bacon on the crops cultivated in the Sudan includes notes on the insect pests that attack some of them, and one by E. Mackinnon on agriculture in Kassala Province contains references to pests and diseases of crops there. An account is given by R. C. Maxwell-Darling (pp. 404–415) of the habits and control of locusts, those of importance being *Schistocerca gregaria*, Forsk., and *Locusta migratoria migratorioides*, R. & F.

Roebuck (A.), Broadbent (L.) & Redman (R. F. W.). **The Behaviour of adult Click Beetles of the Genus** *Agriotes* (*A. obscurus* **L., *A. lineatus* L., and *A. sputator* L.).**—*Ann. appl. Biol.* **34** no. 2 pp. 186–196, 4 figs., 10 refs. London, 1947.

The following is partly the authors' summary. Field studies on the behaviour of adults of *Agriotes sputator*, L., *A. obscurus*, L., and *A. lineatus*, L., were carried out in a grass field in central England in 1944 and in another in 1946. In tests of various methods of trapping, no beetles were caught under large stones placed in the field, very few by net sweeping or on adhesive traps, and fewer per trap on tin lids coated with molasses and sprinkled with grass clippings than in traps comprising a layer of hay, 1 ft. square and 3 ins. deep, placed on closely clipped grass. The hay traps were found suitable for use in studies of population and movements ; the beetles sheltered in these if they entered them by chance, but were not attracted to them. Wireworm populations estimated by the hand-sorting method are likely to be based on the last three instars only [*cf. R.A.E.*, A **32** 306] and are normally reduced by one-third each year after the turf is ploughed up. On the assumption that this reduction is due chiefly to the emergence of adults, it should be possible to estimate the larval population in grassland by multiplying the number of adults present by three. When this was done, the larval populations based on numbers of adults in hay traps and (in brackets) on handsorting in the two fields were estimated at 1,437,480 (1,577,000) and 1,145,440 (1,100,000). The beetles showed maximum activity in late May and early June and during the afternoon and evening, and preferred the most humid sites during dry weather. They became less numerous as the hedge was approached and very few occurred under it. Marked beetles were released, and the maximum distance at which they were recovered was 26 yards. The majority moved in a very restricted area.

Gadd (C. H.). **Observations on the Life Cycle of** *Xyleborus fornicatus* **Eichoff in artificial Culture.**—*Ann. appl. Biol.* **34** no. 2 pp. 197–206, 1 fig., 8 refs. London, 1947.

The author reviews published data on the life-cycle of *Xyleborus fornicatus*, Eichh., on tea in Ceylon [*cf. R.A.E.*, A **5** 282 ; **25** 670 ; **30** 232], describes a method by which it has been reared from egg to adult in the laboratory for the first time with the fungus, *Monacrosporium ambrosium*, on which the larvae feed, and discusses the results. Eggs were collected from galleries, since

oviposition did not occur outside them ; eggs and pupae were maintained in moist chambers and the larvae in tubes containing a culture of the fungus on nutrient agar. Mortality was high, especially among larvae at the first moult and those about to pupate, but sufficient data on the durations of the different stages were obtained for comparisons with previous estimates to be made. The egg, larval and pupal stages lasted 5–6, 9–19 and 4–6 days, respectively, at 28°C. [82·4°F.] ; there were three larval instars. There was no appreciable difference in the length of the life-cycle of insects from castor [*Ricinus communis*] and tea [*cf.* **36** 251], and larvae from one food-plant fed readily on fungus from galleries in the other, but development was slower at lower temperatures. Adults removed from the galleries and placed on sawdust or blotting paper in tubes survived for only 2–3 days when the medium was dry, but for up to 15 when it was kept moist. It is therefore concluded that they cannot survive outside the galleries for long under normal conditions and that the females are unlikely to fly far ; females from tea did not fly in the laboratory, but those from castor were more active. Adults reared from eggs in the laboratory survived for up to 30 days, but few bored into cut stems and the females did not oviposit. Mortality among larvae kept at an altitude of 4,500 ft. at 16–25°C. [60·8–77°F.] was very high and the larval period prolonged to up to 33 days, so that these temperatures appear to be close to the lower limit for the species. Galleries are infrequent in tea at this altitude and are generally empty, indicating that the beetle cannot establish itself permanently there. It is concluded that temperature mainly controls the altitudinal distribution of *X. fornicatus* in Ceylon.

Hewlett (P. S.) & Parkin (E. A.). **The Formation of insecticidal Films on Building Materials. II. Tests of the Efficiency of various Types of Pretreatment.**—*Ann. appl. Biol.* **34** no. 2 pp. 224–232, 1 fig., 3 refs. London, 1947.

The results are given of further work on the effect of pretreatments in prolonging the toxicity of insecticidal films on building surfaces [*R.A.E.*, A **37** 48] ; the spray used was again 1·6 per cent. w/v pyrethrins in Shell oil P31 and the test insects were adults of *Tribolium castaneum*, Hbst. In tests of 30 additional pretreatments on brick, in which the deposit of insecticide solution was about 4 mg. per sq. cm., and the insects were exposed for six days, beginning 24 hours after its application, a saturated aqueous solution of sodium silicate, proprietary sodium silicate, two types of enamel, three types of polyvinyl acetal emulsion, brickwork sealing paint, a 5 per cent. w/v solution of gelatin (edible grade) in water and a 2·5 per cent. w/v solution of sodium alginate (two grades) in water all markedly increased the persistence of the film, the order of decreasing efficiency being that shown, but the other materials tested did not. Seven materials selected from this and the previous work were subsequently tested in the same way on lime-washed brick, wood, cement and a mixture of cement and sand [**37** 47], of which both free and moulded surfaces were tested ; the deposit on wood was reduced to 2 mg. per sq. cm. Starch paste was tested on all the surfaces except lime-washed brick, which it damaged, and greatly increased mortality. Polyvinyl acetal emulsion and brickwork sealing paint greatly increased mortality on all the materials except wood, size on all except lime-washed brick and the moulded surface of the cement mixture, and gelatin on all except the cement mixtures. Polyvinyl alcohol increased the mortality on one surface only and sodium alginate on none, and though they both increased knockdown on some surfaces, further work with them was discontinued.

In practice, spray deposits do not greatly exceed about 1–1·5 mg. per sq. cm., and in tests in which the deposit was reduced to 1·5 mg. per sq. cm., mortality

on free surfaces of cement that had been treated with a 10 per cent. w/v solution of size, 5 per cent. w/v solution of gelatin, starch paste, polyvinyl acetal emulsion and brick sealing paint was never lower than 94 per cent. for a six-day exposure. In further tests the spray was applied at the same rate to cement treated with these materials, and the insects were exposed for three, six or nine days after the deposit had aged for 1–23 days. The decrease in the rate of mortality with increasing age of deposit for a six-day exposure was least for size, followed by gelatin, starch paste, polyvinyl acetal emulsion and brick sealing paint, in that order, and the curves obtained were sigmoid, indicating the existence of some simple relation between the availability of the insecticide and the age of the film. The differences in mortality resulting from three- and nine-day exposures, which reflect the rate of loss of toxicity, decreased in the same order. In a discussion of the whole work, it is concluded that the most effective substances for pretreating building materials are those that are comparatively impermeable to the insecticide and are wetted by it.

McIntosh (A. H.). **A Dipping Apparatus for estimating the Toxicity of Insecticides in liquid Media.**—*Ann. appl. Biol.* **34** no. 2 pp. 233–239, 1 pl., 3 figs., 9 refs. London, 1947.

A dipping technique for studying the effect of liquid insecticidal preparations is described. It is applicable to quick-settling suspensions and quick-creaming emulsions as well as to solutions. The insects are placed in a small tube (2 ins. × 1 in.) containing the insecticide and closed at both ends by means of stoppers, and the tube is subjected to end-over-end shaking for 2½–3 minutes under the water of a constant-temperature bath. The stoppers are then replaced by pieces of muslin, through one of which the insecticide is poured out. The wet muslin is dried by pressing it on pads of filter paper, and the tube kept, dry end down, on filter paper at constant temperature for 24–48 hours before the insects are inspected. The method gave consistent results in tests using DDT against *Tribolium castaneum*, Hbst., *Oryzaephilus surinamensis*, L., and *Ahasverus advena*, Waltl.

Reyne (A.). **Notes on the Biology of** *Comperiella unifasciata* **Ishii and its Host** *Aspidiotus destructor rigidus* **nov. subspec.**—*Tijdschr. Ent.* **88** pp. 294–302, 5 refs. Amsterdam, 1947.

Observations in 1927–29 showed that the Coccid that caused severe damage to coconut palms on the island of Sangi (North Celebes) in 1925–27 [*R.A.E.*, A **18** 83] is a new subspecies of *Aspidiotus destructor*, Sign., for which the name *rigidus* is here proposed. It is present in central and western Java, where it is far more numerous than the typical form on coconut at Buitenzorg; in Bali, where an outbreak occurred in 1934–35 [*cf.* **26** 337]; and in some localities in North and South Celebes, though it is of recent occurrence in North Celebes (including Sangi). With the possible exception of the Palau Islands, it is not known to occur elsewhere. It is distinguished from the typical *A. destructor* by its tough cuticle (the only morphological difference), the length of its life-cycle, which lasted half as long again as that of the typical *A. destructor* in comparative tests at Buitenzorg and in Sangi, its oviposition habits, which lead to an accumulation of empty egg shells near the pygidium and not round the whole body, as in the typical form, and the fact that it infests the leaves of mangosteen (*Garcinia mangostana*) and is easily reared on them, while the typical *A. destructor* is not. Its eggs are laid in an advanced stage of development, number not more than 10–12 per female and hatch within four days, whereas those of the typical form are less advanced, number 40–60 per female and require 6–8 days to hatch.

The Encyrtid, *Comperiella unifasciata*, Ishii, which was introduced into Sangi in 1927 against *A. d. rigidus* [*loc. cit.*], was described from another Coccid in Japan [**14** 141] but occurs in South Celebes (round Macassar) and in Java, where it is common near Buitenzorg and was found parasitising subsp. *rigidus* on 86 per cent. of infested coconut leaves in 1929 and typical *A. destructor* on only 3 per cent. This and the limited distribution of the parasite suggest that it attacks typical *A. destructor* only when *A. d. rigidus*, its preferred host, is present, which may account for its failure to become established in Fiji [**23** 279]. The percentage parasitism of *A. d. rigidus* rose to 80–90 in some colonies at Buitenzorg but was usually not more than about 5. *C. unifasciata* was introduced into Sangi from Java on coconut seedlings infested by *A. d. rigidus*, which were exposed in the crowns of coconut palms in the area of infestation. About six months later, the parasites were abundant on the palms and were recovered from trees up to 110 yards from the ones on which they were liberated ; a year after the introduction they had spread ten times as far. Several other introductions were made, and the parasite could usually be found near the original trees 6–12 months afterwards. Of 53 leaf-samples infested by *A. d. rigidus* that were collected throughout the island 2½ years after the first introduction, 49 contained *Comperiella*. The maximum percentage parasitism in each sample was determined by examining leaflets contained in each, and the average of the maxima was found to be about 12 per cent. The average parasitism for all the leaflets (about 1,200) was not calculated but did not exceed that found at Buitenzorg.

The results of experiments in Java in which *C. unifasciata* was reared on typical *A. destructor* and *A. d. rigidus* in cages on young coconut palms are shown in a table. When the hosts were nymphs in the late second instar or young adults in the preoviposition period, development from oviposition to emergence occupied 26–28 days in *A. d. rigidus*. Experimental parasitism of first-instar nymphs was obtained in both hosts, and although the duration of development was longer (40 days in typical *A. destructor* and 46 in *A. d. rigidus*), the percentage emergence of pupae was high (69 and 95 per cent., respectively), as was also the number of offspring. The parasites appear to feed principally on the ovaries, which are not fully developed until after the second moult. In general, the percentage emergence was lower from pupae in typical *A. destructor* than from those in *A d. rigidus* (67·5 and 87·5 per cent., respectively), and the number of offspring was much smaller. The inferiority of the typical form as a host is thought to be due to its shorter preoviposition period, which lasts only 4·5–5·5 days, as compared with 12–17 in *A. d. rigidus*. Parasitism of *A. d. rigidus* is still possible at the end of the preoviposition period, and a few parasitised scales produced eggs. This does not occur in the field, however, where larvae of *Comperiella*, even the youngest stages, are found only in hosts that have completed the second moult but are in the preoviposition period. The parasites emerge only after the first eggs of *Aspidiotus* in the same colony have hatched. In the experiments, *Comperiella* emerged from individuals of typical *A. destructor* averaging 51 days old and from those of *A. d. rigidus* averaging 60, indicating that the two forms were parasitised at average ages of 24 and 33 days, respectively, or when they had just completed the second moult.

The author considers that parasites and predators do not effectively control *A. d. rigidus* in Java, and that even 90 per cent. parasitism does not always prevent the Coccid from increasing. This is due to the overcrowding that normally occurs on a tree, so that the removal of some individuals merely makes room for others that would otherwise not become established. The collapse of the outbreak on Sangi was not due to the introduction of *Comperiella*, which was then established in only a few localities in small colonies ; the Coccids died from some other cause, presumably internal weakness induced by

deterioration of their food-supply [*cf.* **18** 83]. Both *A. destructor* and *A. d. rigidus* are parasitised by *Aphelinus chrysomphali*, Merc., the percentage parasitism of *A. d. rigidus* on Sangi being 0·1.

KUENEN (D. J.). **On the ecological Significance of two Predators of *Metatetranychus ulmi* C. L. Koch (Acari, Tetranychidae).**—*Tijdschr. Ent.* **88** pp. 303–312, 1 fig., 4 refs. Amsterdam, 1947.

Notes are given on the bionomics of *Paratetranychus pilosus*, C. & F. (*Metatetranychus ulmi*, Koch) on fruit trees in Holland, based on work already noticed [*R.A.E.*, A **34** 91], and on those of the Coccinellid, *Stethorus punctillum*, Weise (*Scymnus minimus*, Rossi) and the Gamasid mite, *Typhlodromus similis*, Koch, which are predacious on it, together with a discussion of the changes in the numbers of all three that were observed on three varieties of plum in Holland in 1943. Apart from an unidentified species of *Typhlodromus*, less numerous than *T. similis* and indistinguishable in behaviour, no other predator of *Paratetranychus* was found on the plum trees in that year. *S. punctillum* hibernates in the adult stage. The eggs are laid in May and early June on leaves on which *Paratetranychus* occurs, and the larvae feed exclusively on all stages of the mites, including the eggs. They become full-fed in about six weeks and pupate on the undersides of the leaves. The adults emerge in late July or early August and give rise to a second generation, the adults of which hibernate. The adults are found only occasionally on the leaves and are far less important as predators than the larvae. *Typhlodromus* also overwinters in the adult stage ; the adults become active in spring and the eggs can be found in summer on the lower surface of the leaves. Little is known of the bionomics of *Typhlodromus*, but it is certain that it has more than one generation a year. It does not feed on the eggs of *Paratetranychus*, and the numbers of this mite destroyed by an individual in a given time are far smaller than the numbers destroyed by a larva of *Stethorus* if the supply of prey is adequate.

Between 3rd May and 11th October, weekly counts were made of the numbers of *Paratetranychus* and its predators per 100 leaves on the three varieties. The results, which are tabulated, showed that the populations differed, but that infestation, which was only moderate, began to diminish towards the end of August, owing to the abundance of predators. Eggs of *S. punctillum* were deposited in about equal numbers on all three varieties, but differences in the numbers of larvae on them were evident in early June. All those on the variety most lightly infested by *Paratetranychus* died before 23rd June, whereas considerable numbers developed on the other two, and pupae were found from 13th July onwards. In August, only a few larvae were left on the less infested of these two varieties, and there were no pupae, whereas there were more larvae on the other and a few pupated ; more eggs were also laid on it, possibly because of the greater food-supply available for the adults. *Typhlodromus* was rather scarce up to the end of July, but it increased in early August and continued to do so until mid-September, when it decreased abruptly. It increased less on the variety with the lowest Tetranychid population than on the others, but continued to increase after the decrease of the prey, and only declined when the prey became very uncommon.

A comparison of the figures showed that *Typhlodromus* was much more efficient in reducing the numbers of *Paratetranychus* than the Coccinellid. The reason for this is thought to be that predators of which an individual consumes large numbers of prey starve when the prey is still relatively abundant, whereas predators that individually consume few can maintain themselves when the prey is scarce and thus continue to reduce it at very low population levels.

VAN DER VECHT (J.). **Het verband tusschen populatie-dichtheid van gastheer en parasiet bij sommige tropische insecten.** [The Connection between Population Density of Host and Parasite among some tropical Insects.]—*Tijdschr. Ent.* **88** pp. 427–434, 7 refs. Amsterdam, 1947.

Investigations were carried out in Central Java in 1938–41 to find the reason for sudden fluctuations in the population of the Zygaenid, *Artona catoxantha*, Hmps., which is present on coconut palms throughout the year and sometimes occurs in outbreak numbers [*cf. R.A.E.*, A **28** 231, etc.]. An outbreak that began in 1935 and spread over a wide area during the next three years resulted in the defoliation of more than a million coconut palms, which bore no nuts for about 18 months. Development from egg to adult lasts about five weeks, and the adults are in flight for about a week, during which the females lay 50–80 eggs each. As there is no diapause, there are nine generations a year.

The investigations involved counts every six weeks of all stages of *Artona* and of its parasite, *Apanteles artonae*, Rohw., on samples of leaves from palms 20–25 years old at Japara. The results showed that the population of *Artona* fluctuates annually with the rainfall. It is small in the last months of the dry east monsoon and increases rapidly when the rains begin, as also does that of *Apanteles*. It then fluctuates for a time, but returns to its original low level during the following east monsoon. When outbreaks occur, the successive generations are found to be sharply distinct, and all the individuals taken at a given time are at approximately the same stage of development [*cf.* also **18** 611], but when infestation is light, as at the beginning of the rains, all stages are present at the same time and the generations overlap. This condition is favourable to the increase of *Apanteles*, the life-cycle of which lasts only about a fortnight, since there is a fairly constant supply of larvae available for oviposition. Owing to the action of the parasite, however, the population of *Artona* is brought back to the condition in which most of the individuals are of about the same age, which, in turn, is unfavourable to the development of *Apanteles*. This process is sometimes carried so far that the parasite is almost eliminated, which may explain why it is seldom of importance during periods of great host density. Similar cases of the failure of parasites are reviewed from the literature [*cf.* **18** 612 ; **25** 191 ; **29** 106], and it is suggested that the possible part played by cultural and control measures in producing the single-stage condition of an insect pest requires investigation.

DE WILDE (J.). **Over enkele belangwekkende parasieten van de koolvlieg *Chortophila brassicae* Bché.** [Some interesting Parasites of *Hylemyia brassicae*.]—*Tijdschr. Ent.* **88** pp. 531–536, 4 figs. Amsterdam, 1947.

Since puparia of *Hylemyia* (*Chortophila*) *brassicae*, Bch., collected in cabbage fields in 12 districts in Holland in 1942 were parasitised by the Cynipid, *Cothonaspis rapae*, Westw., and Staphylinids, further observations were made in 1943 ; 128 puparia of the fly collected from a field between 12th and 18th August 1943 were observed until 24th September. Adults of *H. brassicae* emerged from 36 per cent. of them, *C. rapae* from 2 per cent. and the Staphylinids, *Aleochara bilineata*, Gylh., and *A. bipustulata*, L., from 37 and 5 per cent., respectively. There was no emergence from the remainder. The two species of *Aleochara* have similar life-histories, and the observations made on them largely confirmed those of Wadsworth [*R.A.E.*, A **3** 616]. The adults live in the soil near the roots of the cabbage plants. When placed in petri dishes containing soil, they quickly burrowed into it, but came to the surface to feed. They eagerly devoured larvae and the contents of broken puparia of *Hylemyia* but not puparia that were intact. Pairing was observed, and eggs were laid in

the soil. Larvae were subsequently seen near puparia and required 1–3 days to enter them ; 1–5 larvae were found in each puparium, but not more than one completed its development. When puparia were opened in late September, a few days after being attacked, it was found that the larvae had grown but not moulted, which suggested that larvae entering puparia in September or later overwinter in the first instar. The larvae fed externally on the pupae ; they pupate within the puparia.

PERROT (E.) & others. **Manuel de phytopharmacie. Tome I.**—[4+] 618 pp., 68 figs., refs. Paris, Masson et Cie, 1948. Price *Fr.* 850. **Tome II.**—[4+] 368 pp., 155 figs., refs. 1948. Price *Fr.* 650.

These volumes are the first two of three on plant protection and its practice in France. The bulk of the first is by E. Perrot (pp. 13–346), who, after reviewing the history of professional plant protection there, describes the damage caused by a large number of insect, fungous and other pests to cultivated plants of all kinds arranged alphabetically in groups. He also gives information on pests that attack stored products and methods of preventing and controlling infestation by them, the value of natural enemies in pest control, the uses, preparation and properties of various toxic materials (chiefly insecticides) of plant origin and the cultivation of the plants from which they are derived, the usual methods of control of pests by cultural physical and chemical measures, the forms in which insecticides and fungicides can be applied, and causes of failure following their use. In a concluding chapter, he discusses the organisation of plant protection in France. The second part is by R. Fabre (pp. 347–599) and contains the text of the French legislation relating to pest control, with explanatory comments, and a critical examination of the legislation relating to materials that are toxic to man.

The second volume also consists of two parts, in the first of which (pp. 1–179) G. Valette and R. Cavier deal with arthropod and Nematode pests of plants. An introductory chapter includes general information on the appearance, life-history and classification of the various orders of insects, after which descriptions and information on the bionomics and control of individual species arranged systematically are given ; pests of stored products are included. Recommendations for the collection and preservation of insects are contained in an appendix. The second part of this volume, by L. Lutz (pp. 181–350), is devoted to fungi and other vegetable pests of cultivated plants, and also includes notes on virus diseases.

DE ONG (E. R.). **Chemistry and Uses of Insecticides.**—$9\frac{1}{4} \times 6$ ins., viii+327 pp., 18 figs., many refs. New York, N.Y., Reinhold Publ. Corp., 1948. Price $6.

This handbook on insecticides and fungicides contains a brief introductory account of the development of chemical control in the United States and separate chapters on arsenic, copper and sulphur and their compounds, other inorganic compounds, mineral and other oils, fumigants, plant derivatives and synthetic organic compounds. The information given includes the chemical nature and properties of the various substances, the ways in which they are applied, the pests against which they are used, methods of manufacture and their advantages and disadvantages in pest control, with special reference to practice in the western United States. The uses of heat, cold and radiation in destroying fungi, insects and other pests are discussed in a final chapter. The eight appendices include an alphabetical list of compounds and proprietary preparations showing their uses, a short glossary of terms, information on the legal requirements covering the manufacture and sale of

insecticides and fungicides in the United States, and official antidotes recommended for use in cases of human poisoning. There is an index to authors mentioned, but not one to subjects.

Bowen (M. F.). **Population Distribution of the Beet Leafhopper in relation to experimental Field-Plot Lay-out.**—*J. agric. Res.* **75** no. 11–12 pp. 259–278, 3 figs., 23 refs. Washington, D.C., 1947.

The following is taken from the author's summary of investigations in Colorado, in 1937, on the value of restricted random plot designs in estimating populations of *Eutettix tenellus*, Baker, in fields of sugar-beet.

The distribution of the leafhopper at the time of the spring dispersal into the sugar-beet fields is in essential agreement with the Poisson law. Later season resident populations apparently conform to the negative binomial and the contagious distributions. The variation between plots was not significantly greater than the variation within plots for the migrant leafhopper populations, which indicates that population heterogeneity was not a significant factor affecting the infestation in the different plots. The later season resident population showed highly significant differences between the plot infestations. Restricted random designs gave little or no reduction in error variance when applied to the migrant beet leafhopper populations, because of the uniformity of the distribution of the insects over the experimental field. These designs, however, effected a significant reduction in the estimate of the error variance when they were applied to the later season resident population. Precautions to be observed in the application of analysis of variance to data of the Poisson type are indicated. This paper views field-plot lay-out solely from the standpoint of the distribution of insect populations, but attention is called to the fact that other considerations may be of importance.

DeLong (D. M.) & Severin (H. H. P.). **Characters, Distribution, and Food Plants of Phlepsid Leafhopper Vectors of California Aster-yellows Virus.**—*Hilgardia* **17** no. 1 pp. 1–14, 6 pls., 21 refs. Berkeley, Calif., 1945.

Severin (H. H. P.). **Evidence of nonspecific Transmission of California Aster-yellows Virus by Leafhoppers.**—*T.c.* pp. 21–53, 3 pls. (2 col.), 69 refs.

The first of these papers contains a key to the six Jassids dealt with in the second, together with notes on their morphology, distribution in North America and habitats and food-plants in California. They are *Phlepsius apertinus*, Osb. & Lathrop, *Texananus lathropi*, Baker, *T. pergrada*, DeL., *T. spatulatus*, Van D., *T. oregonus*, Ball, and *T. latipex*, DeL.

The following is from the author's summary of the second paper, in which it is shown that these species transmitted the virus of California aster yellows [*Chlorogenus callistephi* var. *californicus* of Holmes] in the laboratory. The infections produced by 150 males and 150 females of *T. lathropi*, each kept singly on a healthy celery plant, were 18·7 and 16 per cent., respectively, and by 100 males and 100 females of *T. latipex* 18 and 32 per cent. Lots of 40 males or females of both species, placed on celery alternating with asters, caused lower percentages of infections in celery in daily than in weekly transfers, a fact indicating that the period of exposure of healthy celery to the leafhoppers affects virus transmission. Lower percentages of infections occurred with asters than with celery; and, with one exception, lower percentages of asters were infected in daily than in weekly transfers. Higher percentages of infections occurred with six successive asters inoculated by *T. latipex* every three weeks than in daily inoculations or, with one exception, weekly inoculations, a fact demonstrating that the period of exposure of asters to leafhoppers influences

virus transmission. Since there was an increase in the percentages of infections in celery with lots of five, ten and 20 adults, apparently the number of leafhoppers plays a rôle in virus transmission. The minimum latent periods of the virus in the males and females of *T. lathropi* and in one lot of 80 males of *T. latipex* were 7, 8 and 8 days, respectively. The maximum latent periods in *T. lathropi* and *T. latipex* were 33 and 37 days. The virus was retained by single adults of *T. lathropi* for 5–77 days and by *T. latipex* for 1–42 days after the first infection was produced. Many of the leafhoppers of both species caused only one infection each. Attempts to transmit the viruses of curly top of beet [*C. eutetticola* of Holmes] and Pierce's disease of grape vine by means of the two species were failures. Life-history studies were made of the egg periods, egg-laying capacity and duration of the nymphal instars.

The aster-yellows virus was not transmitted by the first nymphal instar of *T. spatulatus*; probably the latent period of the virus was not completed. All other nymphal instars transmitted the virus. Single males infected 34 per cent. of the celery, and single females 29 per cent. Lots of five males transmitted the virus to 88 per cent. and lots of five females to 72 per cent. of the first set of celery and to 40 and 50 per cent. of the second set, respectively. Lots of 40 males and 40 females infected 28·7 and 17·3 per cent., respectively, in daily transfers to successive celery plants, and 80 and 23·1 per cent. in weekly transfers. Only 0·6 per cent. of the asters were infected in daily transfers and none in weekly transfers to successive asters. Lots of five males and five females kept on asters during adult life infected 8 and 12 per cent. of the asters, respectively. Lots of 40 males and 40 females reared on diseased asters infected 1·7 and 0·7 per cent., respectively, in daily transfers to successive asters. The latent period of the virus in the adults was 6–42 days. One male retained the virus for 84 days and one female for 99 days. Most adults caused one infection and then apparently lost the infective dose. All attempts to transmit the curly-top virus by means of *T. spatulatus* were failures. The leafhoppers did not recover the virus from susceptible plants on which they were collected in the field, such as *Chenopodium murale* and *Amarantus retroflexus*, and transmit it to healthy sugar beets. This leafhopper failed to transmit the virus of Pierce's disease of grape vine (lucerne dwarf) between grape vine and lucerne. There was no evidence that *Eutettix tenellus*, Baker, could transmit the curly-top virus to healthy grape vine seedlings or the virus of Pierce's disease of grape vine to healthy grape vines and lucerne.

Males and females of *T. oregonus* tested singly on healthy celery infected 5 of 14 and 11 of 22 plants, respectively. Lots of 2–10 adults infected 12 of 31 plants.

One hundred males and females of *T. pergrada* kept singly on healthy celery caused no infection, but one aster was infected by one of 50 males. Twelve lots of ten, 25 lots of 20 and five lots of 40 males produced 1, 5 and 1 infection, respectively.

With *P. apertinus*, 13 males and 12 females tested singly infected 7 of 13 and 8 of 14 celery plants, respectively. Lots of 2–30 adults produced 14 infections.

SEVERIN (H. H. P.). **Longevity, or Life Histories, of Leafhopper Species on Virus-infected and on healthy Plants.**—*Hilgardia* **17** no. 3 pp. 121–133, 1 col. pl., 12 refs. Berkeley, Calif., 1946.

This paper comprises an account of investigations on the survival of nine species of leafhoppers on healthy plants or plants infected with California aster yellows [*Chlorogenus callistephi* var. *californicus* of Holmes]. The species were *Colladonus* (*Thamnotettix*) *montanus*, Van D., *C.* (*T.*) *geminatus*, Van D., *Texananus lathropi*, Baker, *T. pergrada*, DeL., *T. spatulatus*, Van D.,

T. denticulus, Osb. & Lathrop, *Cloanthanus irroratus*, Van D., *Euscelis maculipennis*, DeL. & Dav., and *Idiodonus kirkaldyi*, Ball, of which the first five have been shown to be vectors of the disease [*cf.* preceding abstract and *R.A.E.*, A **23** 412].

The following is virtually the author's summary. Evidence is presented that all nine species completed the nymphal stages on celery or asters infected with the California aster-yellows virus, but that the adults died when transferred to healthy celery or to asters. The length of life of single males and females of *T. spatulatus* was greater on infected celery before symptoms developed than on healthy celery. The average total duration of the nymphal stages of *T. lathropi* was less on infected than on healthy celery, with one exception; where small numbers of adults were reared, a high mortality of nymphs occurred on healthy celery and more nymphs were reared to the adult stage on diseased than on healthy celery. The average duration of the nymphal stages of *T. spatulatus* was less on celery infested with the aster-yellows virus than on healthy plants. The time required for the completion of the nymphal stages on sugar beets infected with curly-top [*C. eutetticola* of Holmes] was less than on healthy ones, although this leafhopper is not a vector of the curly-top virus. A statistical analysis of the data on the duration of the nymphal stages of each adult of *T. lathropi* and *T. spatulatus* showed no significance. There was no evidence to show that the total duration of the nymphal stages of *Eutettix tenellus*, Baker, is shorter on curly-top sugar beets than on healthy plants.

SEVERIN (H. H. P.). **Transmission of California Aster-yellows Virus by the first reported Leafhopper Vector in Gyponinae.**—*Hilgardia* **17** no. 3 pp. 139–150, 2 col. pls., 6 refs. Berkeley, Calif., 1946.

DELONG (D. M.) & SEVERIN (H. H. P.). **Taxonomy, Distribution, and Food Plants of *Gyponana hasta*, a Leafhopper Vector of California Aster-yellows Virus.**—*T.c.* pp. 157–159, 1 pl., 6 refs.

In the second of these two papers on *Gyponana hasta*, DeL., accounts are given of its morphology, distribution in the United States and food-plants in California.

The following is the author's summary of the first paper, in which it is shown to transmit the virus of California aster yellows [*Chlorogenus callistephi* var. *californicus* of Holmes] in the laboratory. Fifty males and 50 females reared on diseased celery and tested singly on healthy celery caused 18 and 12 per cent. infections, respectively. One of 50 females reared on diseased celery infected one aster; no infection was produced by 50 males tested singly on asters. The infections of successive celery plants in monthly transfers for four months by lots of five males and five females were 15·9 and 12·2 per cent., respectively; by lots of ten males and ten females, 20·3 and 12·8 per cent., respectively; and by lots of 20 males and 20 females, 20·7 and 9·1 per cent., respectively.

A comparison of the transmission of the virus to successive asters by varying numbers of adults was as follows: by lots of 20 males in weekly inoculations, 6·7 per cent.; inoculations every two weeks, 20 per cent.; by lots of ten males in weekly inoculations, 0 per cent.; and for two weeks, 16·7 per cent.; and by lots of five males during two-week intervals, 1·7 per cent. During periods of two weeks, inoculations of two host plants by lots of 20 males resulted in the following percentages of infections: first set of celery and first set of asters, each 52·4 per cent.; second set of asters, 28·6 per cent.; and third set of asters, 5·3 per cent. Asters are less readily infected than celery. The minimum latent period of the virus in the adults ranged from 19 to 35 days. The virus was retained for a period of 11 to 46 days. Most of the adults produced one infection and then apparently lost the infective dose. Attempts to transmit the

viruses of curly-top of beet [*C. eutetticola* of Holmes] and Pierce's disease of grape vines (lucerne dwarf) by this leafhopper were failures.

Life-history studies were made of the egg periods, egg-laying capacity, and duration of the nymphal stages. The total duration of the nymphal stages of the males required from 73 to 109 days, with an average of 81 days ; females required from 71 to 91 days, with an average of 81 days. One male passed through four moults, all others through five moults. Each instar can be determined accurately from tabulated measurements giving diameter of the head across the compound eyes, and the length of the head, thorax and abdomen.

McKenzie (H. L.), Gill (L. S.) & Ellis (D. E.). **The Prescott Scale** (*Matsucoccus vexillorum*) **and associated Organisms that cause Flagging Injury to Ponderosa Pine in the Southwest.**—*J. agric. Res.* **76** no. 2 pp. 33–51, 9 figs., 4 refs. Washington, D.C., 1948.

The following is from the authors' summary of field and laboratory investigations on the causes of the killing, or flagging, of twigs of young trees of *Pinus ponderosa*, in Arizona and New Mexico [*cf. R.A.E.*, A **32** 150]. Research on this so-called " twig blight " indicates that the characteristic flags and lesions occur only on twigs that have been attacked by *Matsucoccus vexillorum*, Morrison. This Coccid is therefore believed to be the primary cause of the blight, although infested twigs frequently develop no lesions. The intensity of flagging in areas infested with the scale varies widely from year to year. The epidemic conditions that existed in 1933 and 1934 have been followed by 12 years of relatively low infestation. Since scale mortality was much higher on the dead than on the green infested twigs, it is probable that the scale population of the area becomes drastically reduced during epidemic years, and several seasons may be necessary for it to build up to the point where damage to the pine again becomes conspicuous. It was found that tree mortality from the blight has been insignificant and has occurred primarily among seedlings and saplings, and since the affected forest types are well stocked and are valued primarily for watershed protection or recreational use rather than timber production, the damage is of no great economic importance.

Several bacteria and 11 fungi occurred rather frequently in flagged twigs or in lesioned tissue of living twigs. A fungus morphologically similar to *Cenangium ferruginosum* was the most commonly associated with lesioned tissue and it almost invariably fruited on flagged twigs. Inoculation with these fungi and bacteria indicated that none of them is sufficiently parasitic to cause flagging independently. The lesions seem to originate in the phloem at fascicle traces, a condition that suggests close association with the scale, since the preadults usually settle in the axils of the needle fascicles. Many lesions are arrested by the action of a pathological cork cambium that walls off the necrotic tissue before a lethal girdle can be effected.

Dowden (P. B.). **Parasitization of the Oriental Moth** (*Cnidocampa flavescens* (**Walk.**)) **by** *Chaetexorista javana* **B. and B.**—*Ann. ent. Soc. Amer.* **39** no. 2 pp. 225–241, 4 figs., 11 refs. Columbus, Ohio, 1946.

The following is substantially the author's summary. *Monema* (*Cnidocampa*) *flavescens*, Wlk., an oriental species common in Japan, was first observed in Boston, Massachusetts, in 1906 [*cf. R.A.E.*, A **21** 232]. The area of infestation, the only one known in the United States, increased very slowly and in 1943 included only about 300 sq. miles in the environs of Boston. The larvae feed on the foliage of a number of trees, including Norway maple [*Acer platanoides*],

pear and cherry [*cf. loc. cit.*], of which the first is preferred. In 1929 and 1930, *Chaetexorista javana*, Br. & Berg., a Tachinid parasite of *M. flavescens* in Asia, was introduced from Japan [*cf.* **20** 218]. It became established almost immediately, and collections at the liberation points in 1933 indicated that it had parasitised more than 60 per cent. of the *Monema* material collected. It overwinters as a second-instar larva within the hibernating prepupa of the host.

Temperatures between 0 and −5°F. kill a high proportion of the hibernating parasites, but temperatures at least as low as −24°F. do not affect the unparasitised host prepupae adversely. Parasitised host prepupae, however, are killed if the parasite dies. Minimum temperatures of −19°F. occurred in Boston in 1933, and the *Chaetexorista* population was reduced to a very low level. By 1942, however, it had increased to the point where 54 per cent. of the prepupae collected at the liberation points were parasitised, but minimum temperatures of −14°F. in the winter of 1942–43 again severely reduced the parasite population. Considerable mortality of hibernating *Chaetexorista* larvae also occurred during winters when the official minimum temperature at Boston was several degrees above zero. A comparison of the percentages of parasitism at nine collection points over an 11-year period indicates that *Chaetexorista* is parasitising about the same proportion of its host population throughout the whole area sampled.

There is a highly significant correlation between the mean number of *Chaetexorista* eggs deposited and the percentage parasitism that may be shown by curvilinear regression. The female parasite deposits eggs on fewer host larvae than if the eggs were distributed at random, and as the percentage parasitism increases from 30 to about 90 the departure from a random distribution increases. Only one individual of *Chaetexorista* develops in a host. A large proportion of the eggs deposited are therefore ineffective, because they are laid on host larvae already bearing eggs. About 77 per cent. of the larvae found bearing eggs were effectively parasitised, but only 30 per cent. of the eggs laid resulted in the death of a host.

Linsley (E. G.) & MacSwain (J. W.). **Factors influencing the Effectiveness of Insect Pollinators of Alfalfa in California.**—*J. econ. Ent.* **40** no. 3 pp. 349–357, 1 fig., 27 refs. Menasha, Wis., 1947.

The following is from the authors' summary. From observations in California on the insect pollinators of lucerne, made during and after a survey already recorded [*R.A.E.*, A **35** 174], it is concluded that maximum seed production there appears to depend on the pollinating activities of honey bees and many wild bees. In contrast to 1945 [*loc. cit.*], honey bees were more important than wild bees in 1946 in all but one area. Their increased activity may have been due to the dry spring, which possibly caused a pollen deficiency early in the season. The dry season may also have adversely affected the subsequent emergence of native wild bees. In most of the fields in which population trends were followed throughout the period of bloom, the numbers of solitary bees were more stable than the numbers of the pollen-collecting honey bees, but reached their maximum a little later in the season. However, honey-bee populations are subject to manipulation by man, and efforts should be made to increase their numbers in seed-production areas. It was found that the important species of solitary bees involved in lucerne pollination fly more rapidly than the honey bee, trip more flowers per minute and visit a smaller percentage of the flowers on any one plant, thus apparently accomplishing not only more pollination, but probably also a greater transfer of pollen from plant to plant per individual bee. The honey bee, on the other hand, appears

to spend more time in the field than the wild bees and collects pollen earlier and later in the day.

No noticeable effects on the honey-bee populations of certain fields were evident as a result of the addition or removal of apiaries. Apparently honey bees commonly fly long distances in search of pollen and nectar and do not necessarily utilise the most readily available source. Thus, if they are to be used to increase the pollination of lucerne, calculations should be based on an area as a whole, not on individual fields. The possibility of encouraging wild bees should be explored. Factors that favour their increase would appear to include the production of seed in any particular vicinity year after year; keeping summer irrigation to a minimum; allowing uncultivated strips to remain near the fields; preparing fence posts, logs, and dead trees for nest sites; and planting rose bushes and certain other plants in the vicinity to provide suitable nest materials for Megachilids. Eliminating plants that blossom during the same period as lucerne should increase the number of pollinating honey bees and of some of the species of wild bees in lucerne, and wherever possible competition with other seed crops, especially carrots, should be avoided. The abundance and effectiveness of pollinating bees can also be increased by controlling *Lygus* and thus reducing blossom injury by these bugs, provided that the measures employed do not themselves have a detrimental effect on the bees and their activities.

Linsley (E. G.) & MacSwain (J. W.). **The Effects of DDT and certain other Insecticides on Alfalfa Pollinators.**—*J. econ. Ent.* **40** no. 3 pp. 358–363, 9 refs. Menasha, Wis., 1947.

DDT and other insecticides are used in California for the control of *Lygus* bugs on seed crops of lucerne, and since most varieties of lucerne must be tripped and cross-pollinated by bees in order to assure a satisfactory set of seed and lucerne provides one of the most important sources of nectar for commercial beekeepers, field studies were carried out in 1945 and 1946 in connection with extensive control experiments [*R.A.E.*, A **36** 90] to determine the effects of the insecticides on bees that visit lucerne. Population trends of bees during the blooming period of the fields were followed in four of the major seed-producing areas of California by taking counts of the numbers collected in 25 sweeps of a net, and in 1946 cage tests were also made.

It is concluded from the results obtained that when lucerne in bloom is dusted with 3 or 5 per cent. DDT at 20 and 30 lb. per acre or with certain other insecticides, there is an almost immediate reduction in the number of bees in comparison with those present at the same time on the previous day, and that this decrease is usually accompanied by an increase in population in adjacent undusted fields. The numbers rose again after 3–4 days, often to higher levels than before, though when fused dusts of 4 per cent. DDT in sulphur were used, recovery appeared to take longer. In an experiment in which dusts containing 3 per cent. chlordane (Velsicol 1068), 1 per cent. γ benzene hexachloride, 5 per cent. methoxy-DDT (dimethoxydiphenyltrichlorethane) with 50 per cent. sulphur in an inert carrier and 5 per cent. DDT were all applied at about 30 lb. per acre, DDT caused the least reduction in the numbers of honey bees, but in another test in which it was compared with 5 per cent. methoxy-DDT, 5 per cent. DDT caused the greater reduction.

Though high proportions of honey bees collected from fields that had been dusted on the same day with DDT died within 24 hours, large-scale bee mortality under field conditions has not yet been demonstrated experimentally, and depressions in bee populations after the application of certain insecticidal dusts may be largely or partly the result of some repellent action. It is not known whether the insecticides kill enough of the native wild bees and honey

bees to reduce tripping and cross-pollination or to affect beekeepers economically, but if DDT is to be used for the control of *Lygus* it should be applied as early in the growth of the plant as the Mirid population warrants ; a second application should be made only when absolutely necessary.

Schwardt (H. H.), Newsom (L. D.) & Norton (L. B.). **Increasing Red Clover Yields by Treatment with DDT or Hexachlorocyclohexane.**—*J. econ. Ent.* **40** no. 3 pp. 363–365, 1 ref. Menasha, Wis., 1947.

A preliminary attempt was made to determine the extent of insect injury to red clover in New York and the possible hazards due to insecticidal residues remaining on the plants. Plots in a meadow sown with a mixture of clover and timothy grass [*Phleum pratense*] and in its first crop year were dusted with 1 per cent. DDT on 13th, 20th and 27th May and 3rd June, 2 per cent. on 13th and 29th May or 3 per cent. on 13th May and 3rd June, or with 1 per cent. benzene hexachloride (giving 0·133 per cent. γ isomer) on 13th, 20th, 29th May and 3rd June, 2 per cent. on 13th and 29th May or 3 per cent. on 13th May and 3rd June, all applications being made at 50 lb. per acre, and the crop was cut on 6th July. The yield of clover hay was significantly higher on all treated than on untreated plots, but there was probably no significant difference between treatments, though the yield was greatest on plots dusted with 1 or 2 per cent. benzene hexachloride, which increased the dry weight by over 10 per cent. Shortly before cutting, the much better condition of the treated plots was shown by their greener colour, greater percentage of flowers and small proportion of timothy grass.

The principal injurious insects present on the clover were *Hypera meles*, F., *Tychius griseus*, Schaeffer, *Lygus oblineatus*, Say, *Sitona hispidulus*, F., *Philaenus leucophthalmus*, L., *Empoasca fabae*, Harr., *Hylastes* (*Hylastinus*) *obscurus*, Marsh., and several species of Aphids. Reduction in infestation was greatest for *Hypera meles* and *P. leucophthalmus* ; Aphids were significantly reduced soon after each treatment, but increased again rapidly, and infestation by *L. oblineatus* and *E. fabae* was too small to yield significant results. Four applications of 1 per cent. DDT or benzene hexachloride reduced infestation by *Hylastes* from 45 to 30 and 18 per cent., respectively, which was significant but not adequate.

Hay from the three plots treated with DDT was mixed and supplied to a dairy cow daily from 8th August to 8th October, analysis of the hay showing that the maximum daily dose the animal could have obtained was 121 mg. No symptoms of DDT poisoning were observed, but analysis of the milk 26 days after feeding began showed a DDT content of 0·22 parts per million, and subsequent analyses made at intervals of 3–7 days from 7th September to 2nd October showed a fairly continuous increase to a maximum of 0·92 p.p.m. on 25th September. Although this is a relatively small DDT content, butter made from the milk might contain about 26 p.p.m. of DDT. No DDT was found in a blood sample taken on 8th August or in urine samples taken on 12th and 22nd August ; faecal analyses made on 12th and 30th August were negative, but one made on 20th September showed the presence of 0·04 p.p.m. DDT. Hay from the plots treated with benzene hexachloride was given to a second cow without observable effect on its health ; no odour was detected in the milk.

Gaines (J. C.) & Dean (H. A.). **New Insecticides for Boll Weevil, Bollworm and Aphid Control.**—*J. econ. Ent.* **40** no. 3 pp. 365–370, 1 fig., 1 ref. Menasha, Wis., 1947.

In investigations near College Station, Texas, during 1946 on the control of *Heliothis armigera*, Hb., *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov.,

on cotton, BHC (benzene hexachloride) and DDT, alone and in combination, were compared with calcium arsenate on different varieties in four field experiments.

In the first, in which three applications at 6 lb. per acre were made before *H. armigera* moved to cotton and four at 11 lb. per acre after it began to cause injury, 5 per cent. DDT in pyrophyllite had little or no effect on *Anthonomus*, but BHC in fuller's earth (5·75 per cent. γ isomer) and calcium arsenate were equally effective against it and significantly better than a combined dust of 5 per cent. DDT and enough BHC to give 2·88 per cent. γ isomer in pyrophyllite. The DDT and combined dusts gave significantly better control of *H. armigera* than calcium arsenate, but BHC alone increased the infestation. Aphids increased equally on the plots treated with DDT and calcium arsenate, but were rare on the plots that received BHC or the combined dust. Calcium arsenate and the BHC and combined dusts were equally effective in increasing the yield. Some losses occurred on the plots treated with DDT owing to poor control of *Anthonomus*. The BHC mixtures caused skin and nasal irritation to people handling them and also scorched the foliage at certain times early in the season when the plants were succulent, though not severely enough to reduce yield. Red spiders [*Tetranychus*] occurred on the plots treated with BHC and DDT but not in sufficient numbers to be injurious.

In the second experiment, six applications of an average of 12 lb. per acre were made at intervals of five days after *H. armigera* moved to cotton. The treatments tested were similar to those in the first test, and their effect was similar on *Anthonomus* and the Aphid, but injury by *Heliothis* was so heavy on plots dusted with BHC, possibly owing to the reduction of natural enemies, that the yield was less than that on untreated plots. DDT did not reduce *Anthonomus* but was effective against *Heliothis* ; it permitted the development of Aphids, though to a less extent than in the first test, because sulphur was used as the diluent. Calcium arsenate, DDT and the combined dust were equally effective against *Heliothis* and gave yields that did not differ significantly. Red spiders were observed on plots treated with BHC, but not on those treated with DDT in sulphur.

In the third test, eight applications were made at approximately five-day intervals, three at the rate of 7 lb. per acre before *H. armigera* moved to cotton and the rest at 11–12 lb. per acre. Dusts of BHC in pyrophyllite (4·31 and 2·88 per cent. γ isomer) and calcium arsenate were equally effective against *Anthonomus*, but a BHC dust containing 1·44 per cent. γ isomer was ineffective. The addition of 1 per cent. nicotine to calcium arsenate prevented the increase of Aphids but did not significantly increase the yield as compared with calcium arsenate alone. The increased injury by *Heliothis* that occurred on all plots treated with BHC significantly reduced the increase in yield.

In the fourth experiment, the dusts were applied nine times. BHC dust containing 7·5 per cent. γ isomer in the first three applications and 3·75 per cent. in the rest, applied at the rate of 12 lb. per acre, gave significantly better control of *Anthonomus* than calcium arsenate at 9 lb. per acre. Injury by *Heliothis* was greater on plots treated with BHC, limiting the increase in yield on certain varieties of cotton. There was a difference in the numbers of *Anthonomus* and *Heliothis* found on the different varieties. Calcium arsenate and BHC did not affect *Heliothis* in the same way on all the varieties, and this affected the yields.

RAINWATER (C. F.) & BONDY (F. F.). **New Insecticides to control Boll Weevil and Cotton Aphid.**—*J. econ. Ent.* **40** no. 3 pp. 371–373, 1 ref. Menasha, Wis., 1947.

The following is based on the authors' summary. Field experiments were carried out at Florence, South Carolina, to compare the effect of several

insecticides alone and in combination, including BHC (benzene hexachloride) and DDT, against *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton. BHC dust, applied 7–9 times at about 6–12 lb. per acre, gave almost perfect control of the Aphid at concentrations of 1–5·75 per cent. γ isomer in an inert diluent or with 5 per cent. DDT. BHC and calcium arsenate were incompatible, the BHC apparently breaking down completely, and BHC and basic copper arsenate appeared to be partly incompatible, as Aphid control was somewhat less when they were used together than when similar strengths of BHC were mixed with an inert diluent. For control of *Anthonomus*, BHC containing 1–5·75 per cent. γ isomer compared favourably with calcium arsenate, and the mixture of DDT and BHC was more promising than BHC alone. *Ryania* powder (50 per cent.) at 6·3 lb. per acre did not compare favourably with calcium arsenate, BHC or DDT. DDT seemed to give very promising control of many cotton insects, but apparently not of the Aphid. From the standpoint of increased yields, 50 per cent. DDT was the best material tested.

Ewing (K. P.), Parencia jr. (C. R.) & Ivy (E. E.). **Cotton-Insect Control with Benzene Hexachloride, alone or in Mixture with DDT.**—*J. econ. Ent.* **40** no. 3 pp. 374–381, 3 refs. Menasha, Wis., 1947.

The following is substantially the authors' summary. In field-plot experiments on cotton at Waco, Texas, during 1946, BHC (benzene hexachloride) dust containing at least 5 per cent. γ isomer gave satisfactory control of *Anthonomus grandis*, Boh., *Aphis gossypii*, Glov., and *Alabama argillacea*, Hb., but no control of *Heliothis armigera*, Hb. Mixtures of DDT and BHC (5 per cent. DDT and 2·88–4·31 per cent. γ isomer) gave excellent control of *Heliothis* and were also effective against the other three insects. These mixtures were more effective than DDT alone against *Heliothis* and more effective than BHC alone against *Alabama* and the Aphid, and in several late-season experiments gave adequate control of heavy infestations of *Anthonomus*.

In one small-plot experiment, the yield for a mixture containing 5 per cent. DDT and enough BHC to give 4·31 per cent. γ isomer was 1,284 lb. seed cotton per acre, as compared with 678 lb. for 5 per cent. DDT alone and 144 lb. for no treatment. In a large-scale experiment begun when infestation by *Heliothis* first developed, the yields were 1,276 lb. per acre for a mixture containing 5 per cent. DDT and enough BHC to give 2·88 per cent. γ isomer applied at 15·8 lb. per acre, as compared with 162 lb. for no treatment, and 744 and 442 lb. for calcium arsenate applied at 15·3 and 8·6 lb. per acre, respectively.

Three late-season large-scale experiments with a mixture containing 5 per cent. DDT and BHC to give 2·88 per cent. γ isomer were carried out in cotton fields in which the growers had failed to control *Heliothis*. When the experiments were begun, the plants were practically devoid of fruit and were heavily infested by Aphids. All dusts were applied at about 16 lb. per acre. In one experiment, the yield was 1,184 lb. per acre as compared with 99 lb. per acre in the untreated control, and in another there was a gain of 756 lb. per acre over no treatment and one of 591 lb. over a plot treated with calcium arsenate. In a third experiment, the mixture gave a gain of 826 lb. over calcium arsenate and of 564 lb. over calcium arsenate with 2 per cent. nicotine.

In cage and field tests, BHC gave a much quicker kill of *Anthonomus* than calcium arsenate, but it lost most of its toxicity within about two days, whereas its effect against *Alabama* was much more durable than that of calcium arsenate. There was evidence that BHC may be incompatible with standard calcium arsenate [*cf.* preceding abstract].

Against the Aphid, BHC containing 5 per cent. γ isomer was more effective than 3 per cent. nicotine in lime, but BHC containing 2·5 per cent. γ isomer

was less effective. When mixed with 5 per cent. DDT, BHC giving 2·88 per cent. γ isomer was approximately twice as effective as 2 per cent. nicotine in calcium arsenate against a heavy Aphid infestation.

Snapp (O. I.). **Benzene Hexachloride for Control of Plum Curculio on Peaches.**—*J. econ. Ent.* **40** no. 3 pp. 382–385. Menasha, Wis., 1947.

The following is based on the author's summary. The results of cage, single-tree and orchard tests in Georgia in 1946 indicate that BHC (benzene hexachloride) is a promising insecticide for the control of adults of the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach. They show that about 1 lb. BHC, containing at least 10 per cent. of the γ isomer, per 100 U.S. gals. spray is needed for effective control, that BHC is more effective in a spray than in a dust, that concentrations of 6 lb. or less of a 31·6 per cent. water-dispersible powder per 100 U.S. gals. spray will not injure peach fruit, foliage, buds, budwood or other parts of the tree, and that the material may affect fruit flavour adversely if used in sufficient concentration too close to harvest. In preliminary experiments, BHC also showed promise for treating dropped fruits to prevent the emergence and subsequent development of the larvae.

Griffiths jr. (J. T.) & Thompson (W. L.). **The Use of DDT on *Citrus* Trees in Florida.**—*J. econ. Ent.* **40** no. 3 pp. 386–388, 5 refs. Menasha, Wis., 1947.

The following are substantially the authors' summary and conclusions. DDT was used in emulsified solution on *Citrus* trees in Florida in 1944 without detrimental results, but in 1945 and 1946, there were serious outbreaks of *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) following five of six applications, apparently as a result of the destruction of natural enemies, and higher populations of *Phyllocoptruta oleivorus*, Ashm., *Pseudococcus citri*, Risso, and *Paratetranychus citri*, McG., were observed on trees sprayed with DDT. It is therefore concluded that it should not be used on *Citrus* foliage in Florida, though it might be used with safety to control the ant, *Wasmannia auropunctata*, Roger, if applied as a dust barrier about the base of young trees or if applied only to large branches and trunks of more mature trees [*cf. R.A.E.*, A **34** 238].

Walton (R. R.). **Effects of Chlorinated Hydrocarbons and Sabadilla on Insects and Plants.**—*J. econ. Ent.* **40** no. 3 pp. 389–395, 3 refs. Menasha, Wis., 1947.

DDT, BHC (benzene hexachloride), chlordane and sabadilla were tested against six species of insects in laboratory and field experiments in north-central Oklahoma during 1946. The BHC contained 10 per cent. γ isomer. In laboratory tests against *Anasa tristis*, Deg., dusts containing 5 per cent. DDT, 2·5 or 5 per cent. BHC or chlordane and 10 per cent. sabadilla were all effective, but DDT and sabadilla at half these strengths were much less so. In field tests against it on cucurbits, 5 per cent. DDT, BHC and chlordane were all more effective and had a more lasting action than 5 or 10 per cent. sabadilla. Sprays containing 0·06–1 per cent. DDT, BHC or chlordane and dusts containing 10 per cent. sabadilla controlled *Corythucha cydoniae*, Fitch, on *Pyracantha*, but the chlorinated hydrocarbons again gave protection for longer periods than did sabadilla. Dusts containing 5 per cent. DDT, BHC or chlordane were significantly more effective against *Diabrotica duodecimpunctata*, F., and *D. melanocephala*, F. (*vittata*, F.) on cucurbits than 10 per cent. sabadilla, and this was significantly more effective than 5 per cent. sabadilla. Dusts containing 5 per cent. DDT, BHC or sabadilla, deposited on and about the base of young sorghum plants at about 20 lb. per acre on 11th and 14th June protected them from chinch bugs (*Blissus leucopterus*, Say) that were migrating

to them ; BHC gave the best protection. Dusts of DDT, BHC or sabadilla applied as narrow barriers on tamped soil, and 5 per cent. DDT, BHC or chlordane and 10 per cent. sabadilla, applied as dusts to lucerne at about 20 lb. per acre were all relatively ineffective against larvae of *Loxostege similalis*, Gn.

None of the insecticides caused important injury to sorghum, lucerne or *Pyracantha*, but young plants of three varieties of squash were retarded in development by dusting with DDT or BHC, though they made a marked recovery during the remainder of the season. No injury occurred on sugar pumpkins in a test in which dusting with all four compounds was begun when the plants were 42 days old.

Decker (G. C.), Apple (J. W.), Wright (J. M.) & Petty (H. B.). **European Corn Borer Control on Canning Corn.**—*J. econ. Ent.* **40** no. 3 pp. 395–400, 1 graph. Menasha, Wis., 1947.

Since sweet maize grown for canning in Illinois is not normally planted until growing conditions are good and varieties of long maturity are used, it is not seriously infested by the first generation of the European corn borer [*Pyrausta nubilalis*, Hb.]. Successive plantings are made until late June, however, and June plantings attract first-generation adults migrating from maturing field maize, so that moderate to heavy infestation by the second generation is likely in the principal part of the crop. A population of more than 3–4 larvae per plant involves a risk of contaminating the canned product.

Ground equipment is not popular for the application of insecticides to the crop because of the large areas involved, and treatment from an aeroplane was tested in 1945 and 1946. In 1945, the second generation was late, and treatments were applied on 2nd, 10th and 18th September. The results showed that spraying with DDT in oil solution (0·67 lb. DDT per U.S. gal.) and dusting with 5 per cent. DDT were about equally effective, causing 80–89 per cent. reduction in the numbers of larvae per plant, which was within the range expected from the use of ground equipment, and 17–18 per cent. increase in the gross yield. All treatments gave almost complete control of larvae in the main stalk but less of those in the ears, and it appeared that larvae that go through the husk and enter the side of the ear are more easily controlled than those that enter the tip through the silk channel.

In 1946, some tests were made against the first generation, but they were of little value because of the extremely low populations in all plots. When 5 per cent. DDT dust was applied at the rate of 25 lb. per acre against the second generation, the number of larvae per 100 plants was reduced by 78·3, 74 and 84·8 per cent. by one, two and three applications, respectively, by 76–94·3 per cent. by four, and by 76·6 per cent. by five, as compared with the numbers in neighbouring untreated fields. The number of applications varied with the maturity of the plants. During both years the maximum population found in late sweet maize near Rochelle, Illinois, was about 20 larvae per plant, and in both years the use of insecticides reduced the population to 2–3 per plant.

In tests to compare rotenone and *Ryania* dusts with DDT, in which four applications were made between 13th and 30th August, 1 per cent. rotenone, at 40 lb. per acre, gave only 77 per cent. control, whereas a spray of DDT in oil solution (8 oz. per U.S. gal.) at 1·6 U.S. gals. per acre gave 91 per cent., 40 per cent. *Ryania* dust at 40 lb. per acre gave 90 per cent., and 3, 5 and 10 per cent. DDT dust at 40, 25 and 12·5 lb. per acre gave 86, 85 and 87 per cent. The spray caused slight scorching. Several new insecticides were tested, but none showed promise of replacing DDT or *Ryania* ; toxaphene gave fair control, but Rothane [DDD] and benzene hexachloride were definitely inferior, and methoxy-DDT [2, 2-bis (paramethoxyphenyl)-1, 1, 1-trichlorethane] was

practically worthless. Comparison of the individual applications of DDT dusts and sprays in a series showed that the early ones were the most important, inadequate protection early in the hatching period of the second generation permitting a large proportion of the larvae to become established on the relatively mature maize. Weekly measurements of plant height and harvest records failed to show any evidence of either injury or stimulation to the plants by DDT, benzene hexachloride or *Ryania*, and measurement of the residues of DDT on the plants at intervals after the last application showed that they apparently weathered rather rapidly at first and more slowly later. DDT applied in an oil solution was found to leave much higher residues than DDT in water emulsion or dust. Residues were greatest on the foliage and practically non-existent on the kernels, and the chances of contaminating the canned product are remote; it might be undesirable to feed the other plant parts to cattle.

Bigger (J. H.), Decker (G. C.), Wright (J. M.) & Petty (H. B.). **Insecticides to control the European Corn Borer in Field Corn.**—*J. econ. Ent.* **40** no. 3 pp. 401–407, 2 figs. Menasha, Wis., 1947.

The production of hybrid field maize seed is an important industry in Illinois, and delays in planting to avoid damage by first-generation larvae of the corn borer [*Pyrausta nubilalis*, Hb.] frequently lead to losses. In 1945, treatment with dusts containing 1 per cent. rotenone, 3 per cent. DDT with 1·24 per cent. nicotine, 3 and 5 per cent. DDT or 30 or 50 per cent. *Ryania* powder on 26th June and 2nd, 7th and 12th July had a marked effect in reducing infestation and increasing the yield of marketable seed.

In 1946, adults emerged about 1st June and eggs were first observed on 10th June, and from a study of population and life-history records it was decided that treatments should be applied against the first-generation larvae on about 20th, 25th and 30th June and 5th July. Dusts of DDT in pyrophyllite and sprays of DDT emulsifiable concentrates were tested. It was found that the later applications were the more important in controlling the first generation in early maize, that no appreciable benefit was obtained by increasing the amount of insecticide deposited from 0·75 to 1·5 lb. actual DDT per acre, and that 5 per cent. DDT in pyrophyllite was more effective than 3 per cent. Ground dusting appeared to give somewhat better results than dusting from an aeroplane, but this may be due to the fact that drift over the control plants was greater from the latter. When approximately equal amounts of DDT were used, an oil-concentrate spray was superior to a dry dust, but the difference was reduced by adding 2 per cent. of oil to the dust. In 1946, a single application made at the optimum time gave almost as good results as repeated applications, but as many of the early eggs were destroyed by rains, recommendations cannot be based on this result.

It is concluded that the use of an insecticide may permit the grower to plant as early as soil conditions are favourable, afford protection against possible borer damage when the infestation is uncertain, and increase net yields, improve quality and reduce losses due to dropped ears when infestation is moderate to severe.

Neiswander (C. R.). **Variations in the Seasonal History of the European Corn Borer in Ohio.**—*J. econ. Ent.* **40** no. 3 pp. 407–412, 8 figs., 6 refs. Menasha, Wis., 1947.

During the first few years after the introduction of the European corn borer [*Pyrausta nubilalis*, Hb.] into the central United States, extensive studies on its seasonal history in north-western Ohio showed that it had only one generation

a year, with the maximum moth flight occurring about 5th July [*cf. R.A.E.*, A **25** 542]. The appearance of a partial second generation was observed in north-western Ohio and north-eastern Indiana during the summers of 1936 and 1937, accompanied by earlier emergence of moths of the second generation than of those of the single generation [*cf.* **27** 414], and the author considers that by 1944 and 1945 the transition from the single-generation strain to a two-generation strain had progressed to a point at which the entire overwintered borer population transforms to moths much earlier than it did when there was but a single generation per year. In this paper he discusses the recent seasonal advance in the flight period of the hibernating generation in northern Ohio, the present variation in the time of occurrence of this period from north to south across the State, the period of emergence of moths of the summer generation and the variation in the time and amount of emergence of summer moths from different food-plants.

The following is based on his summary. With the change to a multiple-generation type of behaviour, the period of moth emergence for the hibernating generation has advanced about two weeks in northern Ohio, the peak of the flight period being about 5th July during the years 1924–27 and about 20th June during 1943–46. Seasonal history studies at four points in the State during 1943–46 showed that the hibernating generation emerged about two weeks earlier in the south than in the north of Ohio and that the emergence period was intermediate at intermediate points. The time of emergence of moths of the summer generation and the magnitude of the summer moth flight varied greatly with the locality, season and food-plant. In the varieties of sweet maize that mature earliest, about 75 per cent. of the first generation emerged as moths in the same summer in southern Ohio, whereas in northern Ohio the average was about 35 per cent. In a comparison of borer development in different food-plants, it was found that moths emerging in the summer from first-generation larvae that had developed in potatoes appeared earlier and in proportionally larger numbers than those in either dent or sweet maize.

Haviland (E. E.). **Biology and Control of the Allegheny Mound Ant.**—*J. econ. Ent.* **40** no. 3 pp. 413–419, 17 refs. Menasha, Wis., 1947.

The results are given of investigations in Maryland on the life-history and habits, with particular attention to feeding habits, of *Formica exsectoides*, Forel, and of preliminary studies on control measures. The life-history was determined in artificial nests and the seasonal history by periodic field observations over three years.

The following is based on the author's summary. Under natural conditions, the colonies are active from April to October. During this time, new colonies are established by swarming, winged males and females are developed in numbers and the colony increases in population. The food is honeydew, obtained from honeydew-producing insects found on the trees, and the soft parts of insects picked up on the ground.

In artificial nests kept at approximately 70°F., the egg, larval and pupal stages averaged 19·4, 37·1 and 25·1 days; two weeks were required for the callows to darken into normal workers. All foods successfully used for artificial colonies were mixtures of a carbohydrate and a protein. For the carbohydrate portion, 25 per cent. honey was the most satisfactory, apparently supplying the carbohydrate and some of the minerals and vitamins necessary; some of the pure sugars did not enable larvae to complete development. Liver broth or 250 mg. liver extract per 100 cc. liquid satisfactorily supplied the rest of the minerals and vitamins as well as the protein.

The most satisfactory control was obtained by putting a complete barrier band of sodium fluoride round the periphery of the nest. Fumigation with

various materials presented difficulties in application and was only partly effective. Control by poisoned baits was unsatisfactory, owing to the abundance of natural foods and the discrimination of the ants.

Neiswander (R. B.) & Rodriguez (J. G.). **Control of the Spruce Mite.**—*J. econ. Ent.* **40** no. 3 pp. 419–421, 7 refs. Menasha, Wis., 1947.

Paratetranychus ununguis, Jac., is frequently troublesome during hot dry seasons in Ohio, where it is observed most often on arborvitae [*Thuja*], spruce and juniper. The foliage of infested trees loses its deep green lustre and later becomes bronzed or rusty. When the attack is severe, the plants may be defoliated. Young or recently transplanted trees are sometimes killed in one season and older ones may be severely injured and rendered unsightly.

Experiments on control by treatments applied in June on trees 18–36 ins. high were carried out in 1945, when *Thuja* was treated once, and in 1946, when white spruce [*Picea glauca*] was treated once and *Thuja* twice. From the results obtained in both years, it is estimated that Dowspray-17, a preparation containing 13·3 per cent. dinitro-o-cyclohexylphenol as the dicyclohexylamine salt, applied at a concentration of 12 oz. per 100 U.S. gals. water, gave an average mortality of 99·4 per cent. Other materials that also gave good results were a 0·25 per cent. spray of NNOR (a preparation containing 1 per cent. rotenone, other derris extractives and mannitan monolaurate [*R.A.E.*, A **30** 198]), which was tested once in 1945 only, DN-dust 269 (a preparation containing 0·25 per cent. dinitro-o-cyclohexylphenol as the dicyclohexylamine salt) which left a visible residue, and sprays of two experimental preparations stated to contain 1, 1-di(x-chlorphenyl)ethane, which are not at present on the market.

Floyd (E. H.). **Control of the Tomato Fruitworm in 1946.**—*J. econ. Ent.* **40** no. 3 pp. 422–423. Menasha, Wis., 1947.

In Louisiana, *Heliothis armigera*, Hb., is usually more injurious to autumn-grown tomatos than to those grown in spring, possibly because of the absence of maize as an alternative food-plant in autumn. In an experiment on its control in 1946, four treatments were applied five times at approximately weekly intervals from 13th September, when the fruit on the first clusters began to form, until 10th October, when the first fruit matured or showed signs of ripening. The percentage of infested fruit was reduced from 21·28 on the untreated plot to 1·97 and 2·87 on plants treated with 3 per cent. DDT in Attaclay, applied at 25·5 lb. per acre, and synthetic cryolite (95 per cent. with 5 per cent. Attaclay), applied at 22·2 lb. per acre, respectively, and to 6·96 and 12·66 on those treated with calcium arsenate and 2 per cent. chlordane, respectively. Statistical analysis showed that all treatments gave significant control and that DDT or cryolite was significantly better than calcium arsenate or chlordane.

Owens (H. B.), Ditman (L. P.) & Burkhardt (G.). **Liquefied Gas Aerosols for Control of Insects on Eggplant and Broccoli.**—*J. econ. Ent.* **40** no. 3 pp. 423–424. Menasha, Wis., 1947.

In further tests in Maryland in 1946 on the control of *Gargaphia solani*, Heid., on egg-plant [*Solanum melongena*] with DDT aerosols [*cf. R.A.E.*, A **35** 405], plants that had been set in late May received weekly applications from 8th June until 23rd August of an aerosol from a solution consisting of dichlordifluoromethane (Freon 12), DDT, cyclohexanone, Velsicol AR60 and acetone (50 : 5 : 5 : 5 : 35), the amounts used increasing as the plants grew. The

treatment caused considerable reductions of adults of the Tingid and practically eliminated the nymphal masses. The heaviest movement of bugs to the treated plants occurred between 29th June and 15th July, whereas the adult population on untreated plants remained rather constant until after the last treatment. Drift of the aerosol caused a considerable reduction of infestation on the untreated plants, as was shown by the reduction of populations on them after treatment and by the rapid increase 11 and 24 days after treatments were discontinued. There was apparently sufficient residue on treated plants to retard population increase for at least 24 days after treatments ceased.

Flea-beetles began to migrate to the young plants as soon as they were set. The heaviest populations were present during July, but this may have been due to the ability of the larger plants to support larger populations rather than to heavy migration. The treatments effected good control. *Epicauta solani*, Werner, was not found on the plants until 12th August, after which it occurred in moderate numbers on untreated plants, but was rare on treated ones. The plants showed a marked response in growth when protected from insects, the average production per plant being 0·155 bushel in the treated area and 0·024 bushel in the untreated one.

The same aerosol was applied to broccoli from 3rd July to 22nd August, once a week, once a fortnight or when required by evident increase in infestation. Population records showed that it was highly effective against the larvae of *Pieris rapae*, L., and *Trichoplusia ni*, Hb., particularly when applied once a week, and that drift greatly reduced infestations on untreated plants. The treatments also reduced infestation by *Brevicoryne brassicae*, L., but there was a rapid increase after each one. There was no growth response to treatment, the untreated plants being as vigorous as those that had received the aerosol.

KNOWLTON (G. F.). **Mirid Damage to Rye.**—*J. econ. Ent.* **40** no. 3 pp. 427–428. Menasha, Wis., 1947.

Considerable spotting of the leaves of rye was reported from Tooele County, Utah, in May 1946, and a survey showed that large numbers of adults and smaller numbers of nymphs of *Miris ferrugatus*, Fall., were present on self-sown rye and on the edges of some rye fields. Smaller numbers occurred on the rye, and on grasses on uncultivated range land in the neighbourhood. Leaf blotching was common wherever the bug was found and seemed to be caused by it. A smaller Mirid, *Trigonotylus ruficornis*, Geoff., was taken in moderate abundance in several places. *M. ferrugatus* has been collected on grass in many localities throughout much of Utah, often in moderate abundance, has sometimes been encountered in considerable abundance on native and introduced range grasses over restricted areas, and has also been collected on wheat, barley and oats.

FERNALD (H. T.). **The Little Fire Ant as a House Pest.**—*J. econ. Ent.* **40** no. 3 p. 428, 1 ref. Menasha, Wis., 1947.

Wasmannia auropunctata, Roger, which is now present in nearly all of the peninsular portion of Florida, is not only a nuisance on *Citrus* trees [*cf. R.A.E.*, A **29** 475] but also enters houses, where it is attracted by most fatty and oily materials, though not by sweet substances. A column of the ants may travel more than 20 ft. in houses to reach attractive foods, and small numbers, presumably scouts seeking food, may be found about the house at almost any time in summer. The ants do not appear in spring until the weather is quite warm at night and disappear with the first cool weather in autumn, reappearing if warm weather recurs. They do not seem to form definite nests underground, but clusters occur in crevices or under débris on the ground. Such clusters

often appear to be connected with others in the vicinity, and these conditions seem to imply that colonies are divided into two or more foci.

Control is complicated by the lack of definite nests where the queens can be attacked, and by the fact that supplying the workers with poisoned food to take to the queens does not seem to be very effective. The workers themselves can easily be destroyed by spraying them and the trails they follow with DDT or other suitable insecticides, but the ants return after about 10-21 days, and repeated treatment to destroy the workers when they appear, including the use of fatty baits to concentrate them, seems to be the only control method available.

Bourne (A. I.) & Shaw (F. R.). **Control of Black Scale on Gardenias in commercial Greenhouses.**—*J. econ. Ent.* **40** no. 3 pp. 429–430. Menasha, Wis., 1947.

On 16th September 1946, a serious outbreak of *Saissetia oleae*, Bern., was reported on *Gardenia* in a commercial greenhouse in Massachusetts. On many plants both buds and leaves were heavily infested and much of the foliage was coated with sooty fungus. On the same day, one section in the eastern half of the greenhouse was sprayed with 0·1 per cent. DDT as an emulsified solution and another with 0·75 per cent. miscible-type Volck oil, and the rest was sprayed with nicotine sulphate (1 : 500) with the addition of 4 lb. fish-oil soap per 100 U.S. gals. at intervals of 7-10 days from 17th September. Infestation was reduced from 56·5 crawlers and 54·8 older stages per leaf before treatment to 0·2 and 0·3 crawlers and 2 and 3·9 older stages three days after it by DDT and Volck, respectively, and the numbers by 1st October were 2·7 and 2·2 crawlers and no older stages, whereas infestation continued to increase on the plants treated with nicotine sulphate and soap. On 30th October the DDT spray was applied to all the plants in the eastern half of the greenhouse, and on 11th December the new growth and buds of plants that had received two applications of DDT or one of Volck and one of DDT were practically free from scales, while the plants that had received nicotine sprays and one application of DDT had the leaves and buds covered with dead scales and some of the older stages still alive. The new terminal growth was noticeably greater on the former, and the plants were much more vigorous.

DDT and Volck killed all crawlers and most of the older examples that were not more than half grown. Both apparently had a very decided effect on young scales for a long period, and there was no evidence of foliage injury or retardation of growth and no discoloration of leaves by spray deposit.

Romney (V. E.), Whitten (R. R.) & Madden (A. H.). **DDT Wettable Powders and Emulsions used on American and Asiatic Elms.**—*J. econ. Ent.* **40** no. 3 p. 430, 1 fig. Menasha, Wis., 1947.

When sprays prepared from wettable DDT powders were compared with emulsified solutions containing the same amounts of DDT on American and Asiatic elm trees [*Ulmus americana* and *U. pumila*] in Ohio, foliage injury proportional to the amount of solvent used, but accompanied by little or no leaf drop, developed in 24 hours on trees treated with the emulsions [*cf. R.A.E.*, A **36** 144], whereas foliage injury on trees receiving wettable DDT was not apparent for three weeks, but became very obvious after four weeks. Although this injury was in many cases no greater than that resulting from the emulsions, the leaf drop that followed was considered to be excessive.

Sprays containing 16 lb. DDT per 100 U.S. gals. water, prepared from five different 50 per cent. wettable powders, and applied thoroughly to both surfaces of the leaves of small American elms on 4th June 1946 at a pressure of 100-120 lb.

per sq. in. caused light foliage injury and leaf drop in three cases and heavy injury and leaf drop in two after 38 days. It appeared that the wetting agents or diluents used may have been responsible for the injury. Heavy rains washed most of the deposit from the upper leaf surfaces, but most of that on the under surfaces remained for many weeks. Sprays containing 4, 8 or 16 lb. DDT per 100 U.S. gals. water, prepared from 25 and 50 per cent. wettable powders, and one containing 4 lb. DDT (from the 25 per cent. wettable powder), 4 lb. lead arsenate and 1 oz. adhesive per 100 U.S. gals., applied on 17th July, caused no noticeable injury to Asiatic elms in 15 days, but resulted in some leaf drop after 23 days. The 50 per cent. wettable powder caused 95–98 per cent. leaf drop at all concentrations, and the 25 per cent. powder caused 95 per cent. at the highest concentration, 80 per cent. at the lowest, and 70 per cent. when lead arsenate was included. On American elms, the 8 and 16 lb. concentrations caused only slight injury after 50 days and the 4 lb. concentration none. These trees had a different type of foliage from those used in previous tests, and the comparatively light injury may have been due to this or to the difference in the time of year.

Horen (W. P.). **Effects of Ultra-violet Radiation on** *Tenebrio molitor*.—*J. econ. Ent.* **40** no. 3 pp. 433–434, 11 refs. Menasha, Wis., 1947.

The results are given of an experiment in which adults and larvae of *Tenebrio molitor*, L., were exposed to ultra-violet radiation and kept under observation for 24 hours afterwards. It is concluded from them that ultra-violet rays do not penetrate the cuticle deeply and that the insects that died were killed by heat produced by infra-red rays. The adults were more susceptible than the larvae, probably because their darker coloration and tougher surfaces absorbed more infra-red radiation [*cf. R.A.E.*, A **33** 53].

Gaines (J. C.). **Comparison of Insecticides for Cotton Insect Control and the Effect of Copper on Yields.**—*J. econ. Ent.* **40** no. 3 pp. 434–436, 3 refs. Menasha, Wis., 1947.

The results are given of experiments carried out in Texas in 1942 and 1946 to determine the effect on the yield of cotton of copper and zinc applied in an insecticide dust to the leaves and of copper applied independently to the soil [*cf. R.A.E.*, A **33** 335]. The effectiveness of the materials in the control of *Heliothis armigera*, Hb., and *Anthonomus grandis*, Boh., was also observed.

In 1942, infestation by *A. grandis* averaged less than 5 per cent. on untreated plots throughout the season and did not affect the yield. *H. armigera* was numerous and caused considerable injury on the untreated plots. The dusts used were basic copper arsenate, 50 : 50 mixtures of calcium or lead arsenate and Pyrax, and 50 : 40 : 10 mixtures of lead arsenate, Pyrax and zinc sulphate or Copper "34", the latter giving 3·4 per cent. metallic copper in the dust. All were applied at an average rate of 15–16 lb. per acre, except the calcium-arsenate dust, for which the rate was about 12 lb. per acre. Eight applications of all were made at intervals of five days from 19th June to 20th August, but three applications were washed off by rain. Basic copper arsenate gave better control of the bollworm than lead arsenate, and the latter gave better control than calcium arsenate. The addition to the lead-arsenate dusts of Copper "34" and zinc sulphate increased the yield by 18·8 and 19·7 per cent., respectively. The numbers of leaves shed during a period in early August were recorded, but showed little difference in the plots receiving the different treatments. If the copper or zinc acted as a fungicide, this record failed to show it. The basic copper arsenate gave a higher yield than any other treatment, but some of the increase might have been due to the stimulating effect of copper on the plant and its effectiveness in controlling plant diseases.

In 1946, *A. grandis* caused more injury than *H. armigera*. Nine applications of the dusts were made at approximately five-day intervals from 17th June to 6th August, three at an average rate of 6 lb. per acre before *H. armigera* moved to cotton and the later ones at an average of 10·4 lb. per acre after it began to cause injury. Lead arsenate, benzene hexachloride in an inert carrier (5·75 per cent. γ isomer) and calcium arsenate gave about equal control of *Anthonomus*, but lead arsenate gave better control of *Heliothis* than calcium arsenate. Benzene hexachloride prevented increases by Aphids [*Aphis gossypii*, Glov.], but permitted greater injury by *Heliothis* than in the controls. Copper oxychloride added to lead arsenate to provide 5 per cent. metallic copper increased the yield by 14 per cent., but copper sulphate applied to the soil at the rate of 3·3 lb. per acre when the plants were seedlings increased it by only 5 per cent.

Lincoln (C.) & Isely (D.). **Corn as a Trap Crop for the Cotton Bollworm.**—*J. econ. Ent.* **40** no. 3 pp. 437–438, 3 refs. Menasha, Wis., 1947.

The following is substantially the authors' summary. Maize in silk appeared to be effective in most cases in attracting moths of the cotton bollworm [*Heliothis armigera*, Hb.] from cotton during a bollworm outbreak on cotton in Arkansas during the late summer of 1946. In exceptional instances, however, where cotton was heavily infested with Aphids [*Aphis gossypii*, Glov.], severe bollworm injury continued notwithstanding the proximity of silking maize [*cf. R.A.E.*, A **31** 467 ; **32** 125]. In all instances of severe injury in this and previous outbreaks, no freshly silking maize was near the injured fields when the infestation of cotton began. Bollworm outbreaks appear to be favoured not only by the occurrence of Aphids, but also by dry, hot weather, which shortens silking during mid-summer.

Isely (D.). **Relation of Crib Type to Weevil Injury to Corn.**—*J. econ. Ent.* **40** no. 3 pp. 438–439, 6 refs. Menasha, Wis., 1947.

Maize stored on farms in Arkansas is sometimes very severely damaged by *Calandra* (*Sitophilus*) *oryzae*, L., but sometimes escapes injury altogether. From the results of observations in 1941–46, all made in cribs in which the maize was stored from one harvest season until the crop was hardening in neighbouring fields in the following year, the author concludes that the type of crib is an important factor. During dry summers, infestation usually occurs in cribs in barns, but is often absent from open isolated cribs, probably because the moisture content of the maize is more rapidly reduced below the lowest point at which weevils can survive in isolated cribs than in barns. Also, winter temperatures are more unfavourable to weevils in isolated cribs than in barn cribs.

Cockerham (K. L.) & Deen (O. T.). **Resistance of new Sweetpotato Seedlings and Varieties to Attack by the Sweetpotato Weevil.**—*J. econ. Ent.* **40** no. 3 pp. 439–441. Menasha, Wis., 1947.

From observations made in 1939–46 in the course of a co-operative attempt in Louisiana to find varieties of sweet potato that were resistant to *Cylas formicarius elegantulus*, Summers, the authors conclude that large, soft crowns or stems are favourable to the feeding and breeding of the weevil ; that there appears to be no direct relation between crown infestation and root or potato infestation, although there sometimes appears to be a trend in that direction ; and that seedlings and varieties that possess long roots to which the potatoes are attached, so that the potatoes are scattered in the hill, appear desirable for

retarding or preventing weevil attack, since seedlings that possessed these characteristics showed less infestation than other seedlings and varieties grown in tests with them. In the years 1941–46, for which records are available, sweet potatoes of the seedlings that showed the lowest infestation were high in moisture and carotene content and low in starch content, and those that showed the highest infestation were low in moisture and carotene content and high in starch. There appears to be a possibility of breeding sweet potatoes with characteristics that will be unfavourable for weevil attack.

Middlekauff (W. W.), Michelbacher (A. E.) & Swanson (C.). **Increase of Frosted Scale following Use of DDT and other Sprays.**—*J. econ. Ent.* **40** no. 3 pp. 442–444, 11 refs. Menasha, Wis., 1947.

Additional observations are recorded on the comparative increase of *Eulecanium* (*Lecanium*) *pruinosum*, Coq., following the use of DDT and other sprays for one or two seasons to control the codling moth [*Cydia pomonella*, L.] on single-tree and commercial plots of walnut in California [*cf. R.A.E.*, A **36** 155]. All the trees were dusted 2–3 times with nicotine against Aphids, and these treatments apparently gave some control of the Coccid. Applications of sprays of DDT for two years in succession resulted in a considerable increase of the scale. Counts of immature scales showed that trees receiving no treatment or standard or basic lead arsenate had averages of 0·3–0·8 per twig, whereas those that had received one spray of 1 lb. actual DDT per 100 U.S. gals. in May in both years averaged 9·3 per twig on single trees and 65 on commercial plots, though a tree that received the same spray twice in each year had only 4 per twig, the second application (in June) apparently killing some of the crawlers. Two sprays of 8 oz. actual DDT and 1 lb. dry nicotine concentrate (14 per cent.) per 100 U.S. gals., applied to a commercial plot in May and June 1946 resulted in no increase in scales. On single trees, two applications of 1 lb. DDD [dichlordiphenyldichlorethane] per 100 U.S. gals. in 1946 resulted in an average of 2 immature scales per twig, and in commercial plots, one application of 1 lb. methoxy-DDT (dianisyl trichlorethane) per 100 U.S. gals. resulted in 7. The less severe infestation on treated single trees may have been due to an influx of parasites and predators from adjacent trees that did not receive DDT.

Scholl (J. M.) & Medler (J. T.). **Spittle Bugs in relation to Alfalfa Seed Production in Wisconsin.**—*J. econ. Ent.* **40** no. 3 pp. 446–448, 1 fig., 3 refs. Menasha, Wis., 1947.

Philaenus leucophthalmus, L., has become an economically important pest of lucerne in Wisconsin during recent years, particularly south of Green Bay and between Lake Winnebago and Lake Michigan. A list of its varieties is given, showing their relative frequency on this crop in two areas in 1946. Both nymphs and adults feed on the plants and both cause dwarfing and a bunchy-top condition. Heavy nymphal feeding probably weakens the plants and reduces the amount of bloom, and the adults may also cause seed injury. This was investigated in 1946, when adults were caged with plants that had finished flowering and bore green seed-pods. Examination when the pods were mature showed that 50·5 per cent. of the seed in infested cages and only 18·6 per cent. of that in the uninfested cage was shrivelled.

Both nymphs and adults should be controlled in fields that are to be used for seed production. In 1945, dusts containing 5 per cent. DDT or 10 per cent. sabadilla, applied at the beginning of August, had little apparent effect on the population, but resulted in yields of 8 and 3 lb. seed, as compared with 2 lb. for no treatment. Sprays and dusts of sabadilla, nicotine and rotenone, applied on 13th June 1946, when the nymphal infestation was 82·5 per cent., did not

reduce it significantly. To test the effect of a trap strip, a 28 ft. swathe was cut through a 7-acre field on 20th June 1946, and on 5th July, when the swathe showed about six inches of new growth, the rest of the field was cut. *P. leucophthalmus* and other insects migrated into the strip, which was dusted with 5 per cent. DDT at the rate of 70 lb. per acre on 8th July. The number of adults averaged ten per sweep of a 12-inch net just before dusting and only one per sweep the next day. No other treatment was given to the field, and the seed harvest was 320 lb. per acre from the trap strip and 132 lb. per acre from the rest of the field, the difference perhaps being due to the prolonged action of DDT on other injurious insects and the difference in time of cutting.

Scholl (J. M.) & Medler (J. T.). **Trap Strips to control Insects affecting Alfalfa Seed Production.**—*J. econ. Ent.* **40** no 3 pp. 448–450, 1 graph. Menasha, Wis., 1947.

Preliminary results are given of tests of trap strips for the control of insects that reduce the production of lucerne seed in Wisconsin [*cf.* preceding abstract]. In 1945, a trap strip 15 ft. wide was cut lengthwise through a small field 74 ft. wide on 15th June, and it was observed that insects left the stubble and concentrated in the adjacent uncut areas. On 25th June, the remainder of the field was cut, and migration took place to the trap strip. Ten days later, it was dusted with 10 per cent. DDT at the rate of 25 lb. per acre, and counts made before and after treatment showed that the numbers of *Adelphocoris lineolatus*, Goeze, *Lygus oblineatus*, Say, and *Empoasca fabae*, Harr., were reduced in the main part of the field by migration into the trap and in the trap strip by the action of the DDT. Similar results were obtained in an adjacent field in which a trap strip left when the rest of the field was cut on 6th July was dusted with DDT.

In 1946, strips were cut in four fields and dusted with 5 per cent. DDT at 40–70 lb. per acre about 2–3 weeks later. Counts of *L. oblineatus*, *A. lineolatus*, *A. rapidus*, Say, *E. fabae*, and *Philaenus leucophthalmus*, L., before the traps were cut and before and after they were dusted showed that there was a reduction in the total numbers of insects on the trap strips in two fields after dusting but an increase in the others. This discrepancy was possibly due to the fact that the dust was applied three or four days after the remainder of the field was cut in the former, but before the remainder was cut and when more than half was still uncut, respectively, in the others. Samples taken in two fields from strips parallel to the traps showed no significant difference in yield of seed in the untreated parts of the fields for a distance of 300 feet. The trap strips produced much higher yields of seed than the rest of the fields, possibly because of the residual effect of the insecticide or the longer time available for blooming and maturing seed. It is also possible that pollinating insects were concentrated on the traps before the rest of the fields came into bloom, and that the early cutting of the traps may have enabled them to escape the severe drought that occurred in many districts in the late summer.

Childs (L.). **Effect of DDT on Populations of Codling Moths.**—*J. econ. Ent.* **40** no. 3 p. 452. Menasha, Wis., 1947.

In 1946, ten bait-traps caught 2,831 adults of the codling moth [*Cydia pomonella*, L.] in an 8-acre block of apple trees in Oregon that received a calyx and six cover sprays of 3 lb. lead arsenate per 100 U.S. gals. water, as compared with 183 in a similar block that received the same calyx spray followed by a spray of 1 lb. actual DDT per 100 U.S. gals. at the peak of the seasonal population of the moth in the orchards and another of 1 or ½ lb. DDT per 100 U.S. gals. All portions of the trees were covered with DDT, including the

lower leaf surfaces. In the area receiving two applications of 1 lb. DDT per 100 U.S. gals., 95·2 per cent. of the fruit was undamaged, whereas in that receiving lead arsenate, 46·9 per cent. was undamaged and 4·5 per cent. contained larvae. It is considered that mass reduction of moths contributed to the satisfactory results obtained. Evidence gathered over a period of three years indicates that small-plot tests do not express the full value that DDT has in complete orchard spraying.

Bean (J. L.). *Eumerus strigatus* **reared from decayed Potatoes.**—*J. econ. Ent.* **40** no. 3 pp 452–454, 13 refs. Menasha, Wis., 1947.

In October 1945, rotten and diseased potatoes from a farm in Maine were found to be heavily infested with Dipterous larvae, as many as seven infested tubers and three different types of disease or rot being present in 3 ft. of row. Several apparently healthy tubers contained similar larvae. Adults of both sexes that emerged between 29th March and the end of June 1946 were identified as *Eumerus strigatus*, Fall., an introduced Syrphid that is of economic importance on onion and narcissus but has not hitherto been recorded from potato in the United States. A single male of the Ichneumonid, *Diplazon pectoratorius*, Grav., was recovered from a pupa during rearing.

Owing to the complexities of the various potato rots, it was impossible to determine the cause of the rot in each potato, but several showed the characteristic rot caused by *Fusarium*. The author discusses the possibility of a relation between *E. strigatus* and some of the various potato rots, citing references to relationships between other insects and fungi from the literature. The finding of tubers showing no apparent sign of decay but seriously infested by *E. strigatus* suggests that the larvae can attack and injure healthy tubers. Only by a careful study of this Syrphid and its relation to the known potato rots can its real economic importance be established, but its breeding is favoured by the present practice of leaving all potatoes showing signs of rot or decay in the field during harvesting and the indiscriminate dumping of rotten potatoes taken from storage.

Gaines (J. C.) & Dean (H. A.). **The relative Toxicity of DDT and Calcium Arsenate to Cotton Leafworm.**—*J. econ. Ent.* **40** no. 3 p. 454, 1 graph. Menasha, Wis., 1947.

In view of the increased use of DDT against insects attacking cotton, laboratory tests were carried out in Texas during September and October 1946 to compare its toxicity to *Alabama argillacea*, Hb., with that of calcium arsenate. Individual third-instar larvae that had been collected in the field were fed on known doses of calcium arsenate or 5 per cent. DDT in pyrophyllite, and the percentage kill was recorded after 48 hours. From the results, it was calculated that the median lethal doses were 0·255 mg. per gm. for calcium arsenate and 1·357 mg. per gm. for the mixture of DDT and pyrophyllite.

Peterson (A.). **Larvae of Insects. An Introduction to Nearctic Species. Part I. Lepidoptera and Plant infesting Hymenoptera.**—11 × 8½ ins., [5 +] 315 pp., 84 pls., many refs., multigraph. Columbus, Ohio [the Author], 1948. (For sale by Ward's Natural Science Establishment, Inc., Rochester, N.Y.) Price $5.

This first part of a work on the identification of the larvae of Nearctic holometabolous insects is devoted to the Lepidoptera and plant-infesting Hymenoptera (mostly sawflies). Following introductory sections on collecting and preserving specimens and the use of the terms nymph, larva and pupa,

there are keys to the nymphs, larvae and pupae of the various orders of insects with figures of typical representatives, keys to the larvae of the families of Lepidoptera (including one to the species of Pyralids that infest stored products and another to those that attack maize, sugar-cane and related plants) and phytophagous Hymenoptera, with notes on their habits and morphology, selected lists of species in each family and figures illustrating typical morphological structures of the larvae of Lepidoptera and sawflies in general and of representative species of each family including a few Hymenoptera beyond the normal scope of the work. Bibliographies of the two orders and a glossary of morphological terms are appended.

LINSLEY (E. G.). **Some ecological Factors influencing the Control of Carpet Beetles and Clothes Moths.**—*Pests* **14** no. 7 pp. 10, 12, 14, 16, 18, 19 refs. Kansas City, Mo., 1946.

It was formerly considered that most of the carpet beetles and clothes moths of the United States were introduced from the Old World and exist in North America mainly as household insects, whereas it is probable that more than half the species are indigenous, and the geographical origin of many of the others is in doubt. In the last few years, several extremely persistent infestations by carpet beetles or clothes moths in houses have been found to arise from birds' nests under eaves or in tile roofs, nests of honey bees in walls or chimneys, deserted nests of the hornet *Vespa* (*Dolichovespula*) *arenaria*, F., and in one case nests of *Sceliphron servillei*, Lep., and a survey of central California and the San Francisco Bay region, records of which are given, indicated that nests of birds, rodents, insects and spiders all need to be considered in the control of these insects [*cf. R.A.E.*, A **31** 109, 112; **34** 150].

Most of the carpet beetles and clothes moths studied by the author hibernate as nearly or completely full-grown larvae, though *Anthrenus lepidus*, Lec., overwinters as a newly emerged but quiescent adult. For hibernation, they require a protected and fairly dry environment in the presence of abundant animal products, such as fur, feathers or dead insects, or plant products, such as seeds or pollen, for the resumption of feeding in spring, and in nature these are found in the nests of birds, rodents, insects or spiders in sheltered situations. In spring, the larvae resume feeding and give rise to adults, which, in the case of carpet beetles, fly to flowers to feed and mate. Carpet beetles that have not fed on pollen and nectar lay few or no viable eggs. They later seek a suitable place for oviposition, which must be accessible and protected from moisture. Since the various requirements are better satisfied on the outside of man-made structures than inside them and since both carpet beetles and clothes moths prefer natural animal and plant products to manufactured ones, they are far more abundant out of doors than in houses.

Short accounts are given of the bionomics in California of *A. verbasci*, L., *A. lepidus*, *Attagenus schaefferi*, Hbst., *A. nigripes*, Csy., and *A. piceus*, Ol., and of *Tineola biselliella*, Humm., *Tinea pellionella*, L., *T. fuscipunctella*, Haw., and *Endrosis sarcitrella*, L., all of which are among the species that inhabit the nests of birds, rodents or insects. It is concluded that such nests harbour large numbers of carpet beetles and clothes moths. Those near houses and other buildings are more apt to be heavily infested than those in the open, since the protected environment provides drier conditions and favours survival of the insects, and such nests provide foci for household and warehouse infestations and may invalidate control efforts applied within the structure. Control programmes should include destruction of nests at the end of the breeding season, before the onset of cool weather, which may drive the insects indoors. Care should be taken not to bring carpet beetles into the house on cut flowers.

Such individuals, having mated and fed, are more likely to cause serious infestation than individuals that have reached maturity within the confines of the building.

MUNGER (F.). **Reproduction and Mortality of California Red Scales resistant and nonresistant to Hydrocyanic Acid Gas, as affected by Temperature.**—*J. agric. Res.* **76** no. 7–8 pp. 153–163, 1 fig., 11 refs. Washington, D.C., 1948.

The following is based on the author's introduction and summary. Since most populations of *Aonidiella aurantii*, Mask., on *Citrus* in California probably include individuals that differ in susceptibility to hydrocyanic acid gas [*cf. R.A.E.*, A **32** 9, 204], repeated fumigations are likely to promote the development of resistant strains [*cf.* **34** 302], unless biological factors favour the more susceptible scales. Reproduction and mortality of two laboratory strains [**34** 302] were therefore studied under various temperature conditions, but the results, which are given in detail, afforded no consistent evidence that reproductive capacity or mortality was linked with susceptibility to hydrocyanic acid gas. High fluctuating temperatures up to a maximum of 113°F. increased the mortality of the second-moult stage by an average of 29 per cent. over that observed at 77°. A temperature of 121·5°F. caused complete mortality of some stages, but in nature relatively few scales are exposed to so extreme a temperature. The moulting stages were the ones most susceptible to low temperatures. A sharp drop to 29°F. caused almost complete mortality of scales in the first- and second-moult stages. Mortality was lowest when temperatures were gradually decreased to the same minimum. The evidence indicates that few of the scales produced late in the autumn survive the winter.

SHANDS (W. A.) & SIMPSON (G. W.). **The Production of alate Forms of *Myzus persicae* on *Brassica campestris* in the Greenhouse.**—*J. agric. Res.* **76** no. 7–8 pp. 165–173, 4 figs., 9 refs. Washington, D.C., 1948.

The following is virtually the authors' summary. An account is given of greenhouse experiments carried out in Maine in 1942 to obtain further evidence of the importance of wild rutabaga (*Brassica campestris*) as a food-plant of *Myzus persicae*, Sulz., and a source of infestation of potato by it [*cf. R.A.E.*, A **31** 251]. The study was concerned primarily with the production of winged forms when two variables were involved, namely, the stage of maturity of the plant at the time of infestation, and the size of the initial Aphid population. Plants in four stages of growth, very young, young, early-flower, and mature, were employed and the initial infestations consisted of one, ten or 100 apterous adults. From about two weeks after colonisation, at frequent intervals until death, each plant was examined for winged Aphids.

The fewest alate forms developed on the very young plants, principally because they were too small to support the initial population. When the original infestation consisted of one Aphid per plant, there was no real difference in the number of alate forms developed on plants of the other three stages of growth; but when it consisted of ten, the number on young plants was larger than on early-flower or mature plants, and when it consisted of 100, the number on early-flower plants was almost significantly greater than on young plants.

Among plants of the same stage of maturity, the number of alate forms recovered from young plants was larger when the initial population was ten Aphids per plant than when it was one or 100. Larger numbers were recovered from early-flower plants originally populated with 100 Aphids than from those populated with one. The differences in average numbers recovered from mature plants of each subclass were not significant. In general, the time when

production began, the rate of production, and the time of each production of alate forms appeared to be associated negatively with an increasing order in plant size and positively with an increasing order in size of initial Aphid population.

It appears probable that the principal factors influencing the production of winged forms in this experiment were size of plants, intensity of Aphid infestation, and condition of the plants resulting from the uniform watering procedure employed. Irrespective of the probable factors involved, however, it is evident that *B. campestris* is an important food-plant of *M. persicae* and may constitute a serious source of infestation if permitted to grow in or near potato fields.

PARKER (K. G.) & others. **The Association of *Hylurgopinus rufipes* with the Dutch Elm Disease Pathogen.**—*J. agric. Res.* **76** no. 7–8 pp. 175–183, 16 refs. Washington, D.C., 1948.

Investigations on the relation of *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., to *Ceratostomella ulmi*, the fungus causing Dutch elm disease [*cf. R.A.E.*, A **30** 180], were carried out in 1936–41 in parts of New York State in which the disease occurs sporadically, *H. rufipes* is prevalent and *Scolytus multistriatus*, Marsh., the usual vector of the fungus in the United States, has not been found. The fungus was cultured from various numbers of beetles that emerged in July or August from infected wood, whether this was from a naturally infested tree or had been cut from a diseased tree, stored over winter and exposed to beetle entry for egg-laying in spring, from beetles that emerged in summer from naturally infested but not diseased wood, and from adults and pupae taken from naturally infested material within or at the edge of the area of disease incidence. The percentages of wood samples from non-diseased trees from which infected beetles were obtained were similar to those previously recorded [**29** 645–646] as associated with *S. multistriatus*, and the number of fungus colonies per beetle was about the same. The fungus was also cultured from beetles that had emerged from material from diseased trees in autumn and overwintered in healthy logs from which they were removed in the following spring, and from hibernating adults collected during the winter and spring from their galleries in healthy trees.

Field observations on the incidence of diseased trees in a recently infected part of the area showed that it was very low, averaging one tree in several square miles. The disease frequently attacked the weakest tree in a group, but spread to neighbouring more vigorous trees in the following year. *H. rufipes* was apparently a much less important vector in the area studied than is *S. multistriatus* in the Hudson River Valley, among the reasons for this being that *H. rufipes* usually makes its trial oviposition tunnels in branches that are not vigorous enough for the fungus to spread to living parts of the tree, wood injuries made in connection with hibernation or feeding are not sufficiently frequent, or are made at the wrong season, and *H. rufipes* is much less likely than *S. multistriatus* to make injuries that reach to and into the wood of sound trees and branches.

PATCH (L. H.) & EVERLY (R. T.). **Contribution of inbred Lines to the Resistance of Hybrid Dent Corn to Larvae of the early Summer Generation of the European Corn Borer.**—*J. agric. Res.* **76** no. 11 pp. 257–263, 1 fig., 3 refs. Washington, D.C., 1948.

The following is the authors' summary of their further experiments in Ohio on the resistance to *Pyrausta nubilalis*, Hb., contributed by inbred lines of maize to hybrid combinations [*cf. R.A.E.*, A **31** 91]. The average effect

of parent inbred lines of dent corn on the survival of larvae of the early summer generation of the European corn borer in single-cross combinations in 1939 was compared quantitatively with their effect in double-cross combinations in 1941 involving, with two exceptions, the same lines used in the single crosses. The lines used had previously been rated as resistant, partially resistant, or susceptible to larval survival. The tests were conducted by infesting each plant by hand with an average of 80 eggs in addition to the natural infestation, and dissecting the plants later to count the mature borers. From a low population of borers in single crosses or double crosses involving resistant lines, the number of borers per plant increased by geometrical progression in the crosses involving successively more susceptible combinations. On the basis of the progressions there were 38·3 per cent. as many borers in the resistant as in the susceptible combinations of single crosses, as compared with 25·7 per cent. as many in the resistant as in the susceptible double crosses. A smaller reduction of borers occurred in the presence of a higher infestation in the single crosses than in the double crosses.

A graphical method for determining the possibility of complementary or modifying action of factors for resistance to borer survival is described. One experiment involving 12 inbred lines indicated no effect of complementary or modifying factors in the 36 single crosses tested. From another experiment in which 16 lines were crossed on susceptible line Ill.A, partially resistant Ill.Hy, and resistant Ill.R4 as the common parents, and from still another experiment in which 39 lines were crossed on Hy and R4, it was concluded that whatever complementary or modifying action of factors for borer resistance the inbred lines may have had was not sufficient to be of importance when the variability of the data is considered.

Monro (H. A. U.). **Methyl Bromide Fumigation of Plant Products in Steel Barges and the Holds of Ships.**—*Sci. Agric.* **27** no. 6 pp. 267–283, 10 figs., 5 refs. Ottawa, 1947.

The following is based on the author's discussion and summary. The method developed in Canada for fumigating imported groundnuts in bags with methyl bromide after they had been transferred to railway freight cars [*R.A.E.*, A **35** 30] was extended in 1945–46 to steel barges, wooden schooners and a Great Lakes freighter. It gave prospects of success provided that a fair degree of gas-tightness could be provided, both in the construction of the vessel and by the use of efficient sealing methods. The barges were of the type used on the Mississippi River and required a considerable amount of sealing ; success on the freighter was apparently due mainly to the fact that the bags were loaded on pallet boards consisting of two surfaces of slats separated by 2×4 inch boards, which ensured considerable air-space throughout the load. For temperatures above 60°F., a dosage of 2 lb. methyl bromide per 1,000 cu. ft. is recommended for an exposure period of 24 hours, with the provision of fans to ensure the even distribution of the fumigant. This treatment gave satisfactory control of all stages of *Plodia interpunctella*, Hb., *Ephestia kuehniella*, Zell., *Tenebroides mauritanicus*, L., *Oryzaephilus surinamensis*, L., and *Tribolium castaneum*, Hbst., the five species commonly found in infested groundnuts.

The work provided information on the effective penetration of methyl bromide through piles of bags. In the schooner, the bags at the sides were pressed against the hull and most of the gas evidently had to travel down through the pile itself ; it may therefore be considered that it penetrated through solid piles of groundnut bags for a distance of 10–12 ft. In the barges and schooners, ventilation of the cargo spaces after treatment, as tested by the Halide Leak Detector, was fairly rapid owing to the limited depths of the piles of bags and the comparatively large area of the hatch covers relative to the

cargo space. In the freighter, aeration was facilitated by the presence of side doors in the hull and the pallet boards, but ventilation from the lower holds was slow and atmospheres safe to work in were reached only after 68 hours.

It is concluded that extension of methyl-bromide fumigation to the holds of ocean-going ships would be attended with considerable difficulty, especially with regard to aeration after fumigation, but might be undertaken if modifications were made in the present method of loading, including the provision of suitable ducts for drawing out the high gas concentrations from the deeper recesses of the holds.

Simmonds (F. J.). **Improvement of the Sex-Ratio of a Parasite by Selection.**—*Canad. Ent.* **79** no. 3 pp. 41–44, 1 ref. Guelph, Ont., 1947.

The proportion of females among laboratory stocks of many species of Hymenopterous parasites tends to decrease in successive generations until only males may be produced. In the course of work with *Mastrus* (*Aenoplex*) *carpocapsae*, Cushm., obtained from larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., on apple in Ontario, it was found that this decrease could be checked by breeding from the progeny of females that produced a high proportion of females. With non-selective breeding, the percentage of females had fallen from 54·5 produced by field-collected material to 13·3 produced by the F_4 laboratory generation, though it was 28·1 and 31·5 in the offspring of two F_3 females. Two females of the latter "family" paired with two males of the former produced offspring of which 88 and 62·1 per cent. were females. These and other females of the same families increased the percentage of females in the F_5 generation to 36·3, and the percentages were 26·6 and 39·3 in the F_6 and F_7 generations, which were produced exclusively by parents from families with a high proportion of females. Results were equally successful whether the males and females used for mating were derived from the same or from different parents. Attempts to improve the sex ratio by rearing pupae at different temperatures and keeping ovipositing females at lower temperature at night were unsuccessful. The factors responsible for the decrease in percentage of females are discussed, and it is concluded that the sex ratio is apparently determined genetically by factors probably connected with male sterility that become evident only under laboratory conditions.

Some data on the bionomics of the parasite are given. At 75°F., the durations of the egg, active larval, resting larval, prepupal, and pupal stages were 1–2, 5–10, 1–4, 1–3 and 5–9 days, respectively. The females survived for 13–84 days and oviposited after 1–17; the number of eggs laid per female varied from 0 to 155. Under the conditions of the experiments, 30–40 per cent. of the eggs deposited failed to produce mature larvae, and 5·2 per cent. of the mature larvae did not complete their development, while 18·1 per cent. entered diapause. These factors were not correlated with the sex ratio, but detract from the suitability of the parasite for experimental work.

Dustan (G. G.), Armstrong (T.) & Putman (W. L.). **The Influence of Air Currents on the insecticidal Action of DDT, Benzene Hexachloride, Hercules Toxicant 3956, and Velsicol 1068.**—*Canad. Ent.* **79** no. 3 pp. 45–50, 3 figs., 1 ref. Guelph, Ont., 1947.

As it has been shown that BHC (benzene hexachloride) has a fumigant action and that its effectiveness is reduced by air currents [*R.A.E.*, A **35** 184, 185], further investigations were made of the influence of air currents on it and other recently developed insecticides. Test insects of several species were sprayed, on leaves or plants, with DDT, BHC, chlordane (Velsicol 1068), or toxaphene (Hercules Toxicant 3956) and exposed in cages or on the plants to

air currents produced by a fan. Such exposure greatly reduced the effectiveness of BHC and chlordane and caused some reduction in that of toxaphene, but had no influence on that of DDT. A test in which adults of *Oncopeltus fasciatus*, Dall., were confined in screened dishes in jars containing considerable amounts of the insecticides showed that BHC and chlordane had a pronounced fumigant action, toxaphene had a little and DDT had none.

Brown (A. W. A.), Robinson (D. B. W.), Hurtig (H.) & Wenner (B. J.). **Toxicity of selected Organic Compounds to Insects. Part I. Tests for general Toxicity on Larvae of** *Musca*, *Tribolium*, **and** *Ephestia*, **and Adults of** *Sitophilus*.—*Canad. J. Res.* (D) **26** no. 3 pp. 177–187, 15 refs. Ottawa, 1948.

Brown (A. W. A.), Wenner (B. J.) & Park (F. E.). **Part II. Tests for contact Toxicity on Nymphs of** *Blatella* **and** *Oncopeltis*, **and Adults of** *Tribolium*.—*T.c.* pp. 188–196, 9 refs.

The following are virtually the authors' abstracts. The general toxicity of 127 synthetic organic compounds was tested against larvae of *Musca domestica*, L., *Tribolium confusum*, Duv., and *Ephestia kuehniella*, Zell., and adults of *Calandra* (*Sitophilus*) *granaria*, L. The compounds were mixed in the insects' food in graded concentrations, and their toxicity was assessed by determination of the median lethal concentrations for each of the four species. The most highly toxic compounds were benzene hexachloride and chlordane (obtained by distillation of technical chlordane). The toxicity of DDT was on the average one-half that of the first two compounds, and it was superior to any of the twelve analogues tested. Four chlorinated aliphatic hydrocarbons (hexachlorbutadiene, and the symm- and asymm-heptachlorpropanes) showed a high toxicity related to their powerful fumigant action. A high level of toxicity was shown by benzyl thiocyanate and its chlorinated derivatives. Dinitro-o-cresol, nitrostyrene, dinitrodimethylbutane and dinitro-o-cyclohexylphenol were especially toxic to *Calandra* adults, but were ineffective against *Musca* larvae. Certain aromatic semicarbazones recommended by previous workers gave disappointing results. Of 22 derivatives of morpholine tested, only three showed any degree of toxicity to the four species of insects employed.

The direct contact toxicity of 91 synthetic organic compounds was tested against nymphs of *Blattella germanica*, L., and *Oncopeltus fasciatus*, Dall., and adults of *Tribolium confusum*. The compounds were dissolved in graded concentrations in a mixture of benzene and kerosene and sprayed on the insects in a spraying tower. Their toxicity was assessed by determination of the median lethal deposits for each of the three species. Taking the results with the three species as a whole, the highest contact toxicity was shown by γ benzene hexachloride and chlordane. Dinitro-o-cresol and dinitro-o-cyclohexylphenol were next in order of effectiveness. These were followed by benzyl thiocyanate and its ortho- and parachlor and 2, 4-dichlor derivatives. DDT was sixth and methoxy-DDT was 12th on the list of compounds in order of their average effectiveness to the three species. A number of chlorinated aliphatic compounds that were strong fumigants showed no contact toxicity.

Myburgh (A. C.). **" Gammexane " and DDT in Fruit Fly Baits—a preliminary Study.**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 14–19, 6 refs. Pretoria, 1946.

In view of the increasing difficulty experienced in controlling *Ceratitis capitata*, Wied., in orchards in the western part of Cape Province, preliminary laboratory experiments with bait-sprays containing BHC (benzene hexachloride)

and DDT were made in 1945. The tests were carried out by spraying the inner surface of glass jars, introducing fruit-flies into these when dry and inverting them over glass plates so that a small section of the mouth covered with wire gauze was free. Both the test materials were highly toxic. A water-dispersible preparation of BHC diluted in sugar water to give a concentration of 0·0005 per cent. γ isomer and a semi-colloidal suspension of DDT prepared by diluting a solution of commercially pure DDT in ethyl alcohol with sugar water to give concentrations of 0·05–0·1 per cent. DDT killed the flies more than twice as quickly as standard bait-sprays containing 0·4 per cent. lead arsenate or sodium fluosilicate. At similar concentrations of DDT, a water-dispersible preparation was much less effective. Except when so much was applied that the flies could not avoid contact with the deposits, those from unsweetened sprays were less effective than those from sweetened ones. There appeared to be little difference in the effectiveness of BHC deposits that were one day, one week or three weeks old, even when the oldest deposit had twice been lightly sprayed with water, but in another test BHC baits that were eight days old were less toxic than fresh ones. Deposits of the semi-colloidal DDT remained effective for more than three months in the laboratory and withstood severe artificial weathering with water.

Ullyett (G. C.). **New Species of *Apanteles* (Hym. Bracon.) and new Host Records from South Africa.**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 28–35, 4 figs. Pretoria, 1946.

The new species, which are described from adults of both sexes, are *Apanteles halfordi*, from *Plutella maculipennis*, Curt., on cabbage and watercress (*Nasturtium officinale*), *A. euproctidis* and *A. flaviventris*, from *Euproctis terminalis*, Wlk., a destructive pest of pines in South Africa of which the former is an important parasite, and *A. leucotretae*, from *Argyroploce leucotreta*, Meyr., on *Citrus*, all in the Transvaal. Amendments to D. S. Wilkinson's key to the Ethiopian species [*R.A.E.*, A **21** 135] to include them are given. *A. acraeae*, Wlkn. [*loc. cit.*] is recorded for the first time from South Africa, where it parasitised *E. terminalis* in the eastern Transvaal in April 1945. *A. ruficrus*, Hal., which has been reported from *Laphygma exempta*, Wlk., in South Africa, is recorded from *P. maculipennis* on watercress in the Pretoria district ; it apparently does not attack this host on cabbage.

Matthee (J. J.). **A Study of the Phases of the Army Worm (*Laphygma exempta* Walk.).**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 60–77, 5 refs. Pretoria, 1946.

The following is almost entirely the author's summary. Laboratory investigations carried out in South Africa in 1943–44 confirmed the occurrence of phase variation in *Laphygma exempta*, Wlk. [*cf. R.A.E.*, A **32** 285]. Characters of phase *solitaria* could be intensified by rearing the progeny of parents exhibiting them in isolation through several generations ; all larvae reared in crowds had *gregaria* characters [*cf. loc. cit.*]. In two series of rearing experiments, the *gregaria* lines showed higher percentages (83·7 and 79·3) of second-instar larvae with black heads than the *solitaria* lines (63 and 49·3). Only 11·6 per cent. of the larvae reared in isolation passed through six instars. The rest passed through five. In the crowds, all larvae seemed to pass through six instars. The measurements of the heads of the *solitaria* larvae were significantly greater than those of the corresponding instars of the *gregaria* larvae, except in the first instar in which there was no difference. No difference was found between the duration of the pupal stage in *solitaria* and *gregaria*. Pupae of *L. exempta* are not capable of overwintering at Pretoria ; some of the larvae survive the winter if provided with suitable food.

Lavoipierre (M.). **New Records of Acari from southern Africa and the Belgian Congo.**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 78–81, 9 refs. Pretoria, 1946.

The numerous mites recorded include *Hemitarsonemus latus*, Banks, which was injurious to *Capsicum* at Durban in 1941 [*cf. R.A.E.*, A **29** 320] ; *Podapolipus grassii*, Berl., from migratory locusts [*Locusta migratoria migratorioides*, R. & F.] in Northern Rhodesia and *Morphacris fasciatus*, Thnb., in Natal ; and *Pediculoides ventricosus*, Newp. *P. ventricosus* was found in large numbers in 1944 preying on larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., within their cocoons on apricot and pear in the western part of Cape Province and caused a heavy infestation of larval stock in the laboratory, where the mites were controlled by fumigation with sulphur dioxide. When infested cocoons and larvae were offered to Ichneumonid parasites, the mites attached themselves to the abdomens of the latter and killed many of them.

du Plessis (C.) & Smit (C.). **Preliminary Laboratory Experiments with DDT and 666 as Locusticides.**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 82–88, 2 refs. Pretoria, 1946.

The results are given of preliminary tests of DDT and BHC (benzene hexachloride) in baits, dusts and sprays for the control of locusts. The dusts were tested against hoppers kept in enclosures with alternative food, and the sprays and dusts were applied directly to locusts which were then kept in clean cages for observation. Baits of maize bran containing 0·2, 0·5 or 1 per cent. BHC or 2 or 5 per cent. DDT were compared with one containing 3 per cent. sodium arsenite against hoppers of *Locusta migratoria migratorioides*, R. & F. The mortality percentages in 72 hours were 81, 75 and 62 for 1, 0·5 and 0·2 per cent. BHC, 73 and 63 for 5 and 2 per cent. DDT and 78 for sodium arsenite. The effects of BHC were conspicuous within an hour of application, whereas the other materials were slower in action ; affected locusts did not recover. In tests with sprays containing 5 per cent. DDT or 2·5 per cent. BHC in emulsified solutions applied at rates of 12 and 20 gals., respectively, per acre and a dust containing 10 per cent. DNC (dinitro-ortho-cresol) at 10 lb. per acre against adults of *Locusta*, there was no significant difference between the BHC and DNC, and both gave higher mortalities (97 and 73 per cent., respectively) in 72 hours than DDT (63 per cent.). There was no significant difference in the effectiveness against adults of *Locustana pardalina*, Wlk., of 5 per cent. DDT applied as a solution or in an emulsion. Dusts containing 10 per cent. BHC or DNC applied at 10 lb. per acre against adults of *Locusta* gave 17 and 46 per cent. mortality, respectively, in 72 hours, and the BHC dust at 50 lb. per acre 60 per cent. ; the action of BHC applied in this form was slow. A dust containing 20 per cent. DDT applied at 50 lb. per acre was as effective in 72 hours against adults of *Locustana* as one containing 6 per cent. DNC at 7 lb. per acre, but was slow in action, and more effective against hoppers of *Locusta* than one containing 10 per cent. DNC at 7 lb. per acre.

Rosedale (J. L.). **Insecticides and Enzyme Action.**—*J. ent. Soc. sthn Afr.* **9** no. 1 p. 89, 4 refs. Pretoria, 1946.

Sixth-instar hoppers of *Nomadacris septemfasciata*, Serv., that were prevented by means of collars from bringing their legs and antennae into contact with each other or with their mouths were not killed when their bodies were painted with a solution of 1 per cent. sodium arsenite. King & Ruttledge found that locusts became paralysed and died when sufficient sodium-arsenite dust reached the tracheae, although precautions were taken to prevent the contact of arsenic with the alimentary tract [*R.A.E.*, A **20** 337]. When the author attempted

to repeat their work, using *A[canthacris] ruficornis*, F., arsenic was in each case detected in the alimentary tract by means of the Gutzeit test. Despite this, however, he suggests that the poison may kill insects by altering the rate of enzyme action in them without entering the digestive tract.

Guanine is the first substance to be split off from nucleic acid in developing locusts. Search for the guanine in *Locustana* (*Locusta*) *pardalina*, Wlk., and *Acanthopsyche junodi*, Heyl., yielded a yellow substance attached to protein. This substance can deaminise amino-acids by oxidation, and the reaction, during which pyruvic acid is formed and ammonia given off, is accelerated by a few drops of M/1,000 solution of sodium arsenite or pentachlorphenol ; under such conditions, an accumulation of keto-acids will be formed. It is possible that this accumulation may give rise to paralysis and death.

ULLYETT (G. C.). **Unusual Parasitism by *Chrysis* sp. (Hymen., Chrysididae).**—*J. ent. Soc. sthn Afr.* **9** no. 1 p. 93, 2 refs. Pretoria, 1946.

A cocoon of *Parasa latistriga*, Wlk., on plum, from which no emergence had taken place, was found to contain a dead adult of an undetermined species of *Chrysis*. It is stated that the only other recorded instance of parasitism of Lepidoptera by *Chrysis* is that of *C. shanghaiensis*, Fr. Smith, attacking larvae of *Monema flavescens*, Wlk., in their cocoons in southern Japan and China [**21** 439 ; **24** 561 ; but *cf.* also **19** 174 ; **25** 339, 793 ; **28** 140 ; **29** 588 ; **30** 396, 502]. The habits of the present species in South Africa are likely to be similar to those of *C. shanghaiensis* [**21** 439].

ULLYETT (G. C.). **Use of Ultra-violet Radiation in Insect Rearing.**—*J. ent. Soc. sthn Afr.* **9** no. 1 pp. 93–94, 1 ref. Pretoria, 1946.

In rearing insects on artificial media by a method devised for *Argyroploce leucotreta*, Meyr. [*R.A.E.*, A **28** 641], an aseptic cultural routine is necessary, and the exclusion of air-borne bacteria is particularly important. For this purpose, two tests were made of the Rentschler-James process of sterilisation, which employs light waves in the 2,537 Angstrom unit band produced by a specially designed lamp that is easily installed and operated. A lamp of the same size (Sterilamp No. WL 782—30) was used in both, and equal numbers of culture plates of nutrient agar were exposed for 30 seconds before it was switched on and after it was switched off. In the first test, the plates were exposed on a bench at one end of a room, 10 ft. × 3 ft. 4 ins. and 9 ft. high, and the lamp was installed at the centre of the ceiling and operated for 30 minutes ; in the second the plates were exposed 39 inches immediately below the lamp, which was operated for 40 minutes. The numbers of bacterial colonies that developed on the plates exposed before and after operation of the lamp were 21 and 3, respectively, in the first test, and 34 and 3 in the second. The treatment had no significant effect on fungus infection.

BERKELEY (G. H.), CARTER (Walter) & VAN SLOGTEREN (E.). **Report of the Commission of Enquiry into the Swollen Shoot Disease of Cacao in the Gold Coast.** —Colonial no. 236, 10 pp. London, H.M.S.O., 1948. Price 3*d.* net.

Three plant pathologists from countries not commercially interested in cacao were appointed by the Secretary of State for the Colonies to study the incidence and nature of the swollen-shoot disease of cacao in the Gold Coast and to report on the technical measures necessary for its speedy eradication. This report was prepared by them after a visit to the Gold Coast from 24th October to 3rd December, 1948. They conclude that the disease is a serious danger to

the cacao industry. It is caused by a virus or closely related group of viruses [*R.A.E.*, A **37** 85] transmitted by mealybugs, of which five [those already recorded (**37** 85) and an unidentified species of *Pseudococcus*] are known to be vectors. It spreads very slowly among trees less than 3–4 years old, but much more rapidly in older trees, which form a continuous canopy and are likely to be more severely infested by mealybugs. Cutting out infected trees is the only method available for checking its spread. The destruction of trees of which the canopies are in contact with infected ones is also desirable, but coppicing them might form an alternative measure; the development of symptoms in infected trees not yet exhibiting them would be hastened and they could then be destroyed.

At least four species of forest trees [of the genera *Bombax*, *Ceiba*, *Sterculia* and *Cola* (*cf.* **37** 87)] are known to serve as reservoirs of infection. Their destruction is considered desirable but presents difficult problems owing to the size of some, the risk of serious direct damage to cacao if they are felled and, as a result of opening the canopy, the encouragement of damage by Mirids [*cf.* **37** 88]. At present, therefore, the Commission recommend felling only those on infected farms, except in the Western Province, where a considerable percentage of the principal forest host tree is naturally infected and its removal from the vicinity of all farms, whether infected or not, and from the sites of new plantings is necessary. In view of the limited staff at present available for this work, attention should be concentrated on areas of lesser infection.

Re-establishment of cacao in areas that have been treated is the main problem over most of the Eastern Province. Areas with a low initial percentage of infected trees or where there are scattered outbreaks involving only a few trees can probably be safely replanted after roguing, provided that they are kept under surveillance and retreated where necessary, but where there is a high initial percentage of infected trees, replanting should be delayed until retreatment has ensured the complete removal of diseased trees. The presence of small untreated farms is a serious danger in this connection. Subsidiary measures that may assist in control and the re-establishment of cacao farms comprise planting in straight lines, which facilitates inspection and chemical treatment, the use of seed of better and earlier maturing varieties, and painting young cacao trees with DDT, which is desirable for Mirid control [**37** 89–90] and which is likely to repel and control the ants that are largely responsible for establishing mealybugs on the trees.

Aspects thought to require immediate attention are the development of methods of killing forest trees by means of chemicals and the rapid increase and distribution of the available stocks of earlier maturing and higher yielding selections of cacao. Other lines of investigation considered to be of value are the immunisation of cacao trees from a severe strain of the disease by inoculation with a mild one [*cf.* **37** 86], the development of resistant varieties [*cf.* **37** 87], the development of a rapid method of diagnosis, and the chemical and biological control of the mealybug vectors. Methods for the dissemination of information among growers should be extended and improved.

A statement of the findings of the Commission that was read at a meeting at which growers and Press representatives were present is given in an appendix.

Brimblecombe (A. R.). **Log Storage of Borer susceptible Timbers.**—*Aust. Timb. J.* May 1946 repr. [2] pp. [? Sydney] 1946.

An account is given of a method successfully applied on a commercial scale in southern Queensland on two occasions, in 1941–42 and 1943–45, that enabled logs of timber susceptible to end-splitting and severe infestation by *Lyctus brunneus*, Steph., to be stored until they were required for use by the sawmills.

Sloanea woollsii, a species that is very susceptible to *Lyctus* because of its wide band of sapwood, was used in 1941, and this and *Argyrodendron trifoliolatum* in 1943. Only large logs were used, to reduce the ratio between the treated surface and the protected log volume, injuries to wood and bark during logging were kept at a minimum, and the logs were placed in storage without delay. All loose and injured bark that would permit oviposition was cut away to expose clean wood surfaces, and these and the ends of the logs were immediately sprayed with a hot emulsion of one part creosote in two parts of a solution of 5 per cent. soft soap, to control any infestation already begun, and then liberally coated with warm crude petroleum jelly to prevent fresh attacks. In 1943, supplies of petroleum jelly were limited and crude lanoline was substituted for it on the sides of the logs. Complete protection from *Lyctus* attack was given for periods of up to 22 months, when all the logs had been milled, and end-splitting was negligible.

Kelsey (J. M.). **Insects attacking Milled Timber, Poles, and Posts in New Zealand.**—*N.Z. J. Sci. Tech.* **28** (B) no. 2 pp. 65–100, 36 figs., 16 refs. Wellington, N.Z., 1947.

This paper deals with practical methods of identifying the commoner termites and beetles that damage wooden furniture and timber used in various ways in New Zealand, and their control. Apart from *Stolotermes ruficeps*, Brauer, a damp-wood termite that has been found only once in buildings but may occur more frequently in the future, the former consist of dry-wood termites including four species of *Kalotermes* (*Calotermes*) and *Porotermes adamsoni*, Frogg., and subterranean termites, including three species of *Coptotermes* and *Eutermes walkeri*, Hill [*cf. R.A.E.*, A **33** 234]. Their habits are briefly described, and information is given enabling dry-wood and subterranean termites to be distinguished by morphological characters of the soldiers and winged individuals and also by such criteria as the presence of frass, mud or covered runways. The beetles comprise *Anobium punctatum*, Deg., *Ernobius mollis*, L., *Lyctus* spp., *Platypus* spp., *Torostoma apicale*, Broun, which caused much damage in a house in Auckland, *Ambeodontus tristis*, F., and *Prionoplus reticularis*, White, the last of which is normally associated with decaying wood but attacks sound timber in contact with it or the soil on the damp west coast of the South Island. These beetles, or most of them, can be distinguished by morphological characters of the adults and larvae and also by the situation of the eggs, the way in which dust is packed in the tunnels, the type of frass, the exit holes and the timber attacked. All these differences are described, and notes on the life-cycles given.

Subterranean termites, of which *Coptotermes acinaciformis*, Frogg., is the commonest and most destructive [*cf.* **30** 564], are best destroyed by blowing poison dusts, such as white arsenic or paris green, into the galleries [*cf.* **32** 29], but for dry-wood termites, of which *K. brouni*, Frogg., is the most important, oil-soluble preservatives applied by means of drill and pressure apparatus should be used. This method of application also provides the best control of beetles, though surprisingly good results have been obtained by flood spraying infested boards with the same materials. Neither method is reliable, however, and it is often more economic to replace the infested wood by pretreated timber.

The information on timber preservatives is based chiefly on the results of the International Termite Exposure Tests [**34** 32, etc.] and on preliminary work in New Zealand [**36** 245, 414]. In that country, where, owing to the general use of concrete or brick sub-floor walls and concrete piles, leaching is not likely to be severe, a dip treatment with a minimum duration of 20 minutes is likely to suffice. Of the water-soluble preservatives tested there, those containing arsenic were consistently superior to others ; zinc meta-arsenite,

white arsenic, and Tanalith protected unpainted wood for average periods of over 110, over 90 and 65 months, respectively, whereas untreated controls became infested after 19 months. Water-soluble preservatives are suitable for the pressure treatment of timber, which is best done soon after milling, and can be used for the sapwood of native trees and exotic conifers such as *Pinus radiata*. They should not be used to treat infested timber in buildings as they penetrate seasoned timber very slowly and cause it to swell. Of the oil-soluble preservatives, coal-tar creosote is the cheapest and probably the most effective. In New Zealand, however, timber in buildings that received only one brush or spray coating has become infested by *Anobium*, *K. brouni*, *Coptotermes acinaciformis* and *C. frenchi*, Hill, in periods varying from one month to five years after treatment, and three or four coatings or hot and cold bath treatments are therefore recommended. Other oil-soluble preservatives include chlorinated naphthalene [**36** 415], pentachlorphenol [**36** 107, 415] and zinc naphthenate [**36** 415]. A solution of zinc naphthenate in mineral oil is in commercial use in New Zealand in infested buildings and for the dip treatment of certain timbers. Wood treated with it can be painted, and it does not destroy polished surfaces when properly applied. One brush coating with these materials for each $\frac{1}{4}$-inch of timber thickness is recommended [**36** 415], and this can be supplemented by injecting the fluid into the exit holes. Treatment can be carried out at any time of year, but gives best results against *A. punctatum* during September–February, against *Lyctus* spp. during August–January, against *Ambeodontus* during February–July, against *Torostoma* during November–August, and against *E. mollis*, for which two brush treatments are required, regardless of the thickness of the timber, during October–March.

CLARK (P. J.). **D.D.T. Residues on Cabbages.**—*N.Z. J. Sci. Tech.* **29** (A) no. 1 pp. 1–4, 11 refs. Wellington, N.Z., 1947.

In view of the probable commercial use of DDT for the control of *Plutella maculipennis*, Curt., and *Pieris rapae*, L., in New Zealand, the amount of DDT residue likely to be left when treated cabbages are prepared for market was investigated. The experimental cabbages received six applications (ending on 15th April) of a dust containing 1·5 per cent. p,p′DDT, or a spray suspension containing 0·1 per cent. p,p′DDT, and were harvested on 16th May. The outer leaves were discarded, according to commercial practice, and the inner leaves stripped until the DDT could not have penetrated further. These were analysed by the combustion method of determining total chlorine, whereby the DDT is burned in a current of coal-gas and the liberated chlorine gases titrated by the Volhard method after absorption in alkaline sodium arsenite, and by a colorimetric method employing nitration followed by the addition of sodium methylate dissolved in methyl alcohol. The results showed that the combustion method is unsuitable for determining small quantities of DDT, but provides a rapid method of determining whether the amount present is large or small. Of six dusted cabbages, none bore more than 1·6 parts per million DDT, as determined by the colorimetric method, and of six sprayed ones, none had more than 2·3 p.p.m. A seventh dusted cabbage bore 16 p.p.m. DDT and appeared to have received an excessive amount of dust. The tentative tolerances accepted in the United States and Australia are 7 and 10 p.p.m., respectively.

PRUTHI (H. S.) & MANI (M. S.). **Our Knowledge of the Insect and Mite Pests of *Citrus* in India and their Control.**—*Sci. Monogr. Coun. agric. Res. India* no. 16, iii+42 pp., 6 pls. (3 col.), 22 figs., 4 pp. refs. Delhi, 1945.

The authors review the information available on the insects and mites that attack *Citrus* in India. They describe the distribution, food-plants and status

of more than 160 species, nearly half of which are major pests in India and elsewhere, and the nature of the damage they cause, give short accounts of their life-histories and natural enemies and the control measures used against them in India and other countries, where these are known, and suggest further work that may be carried out under Indian conditions.

Cheu (S. P.) & Li (S. S.). **Further Studies on the Biological Control of Sugarcane Woolly Aphis (*Oregma lanigera* Zehntner) by the Giant Lady Beetle (*Synonycha grandis* Thunb.) in Kwangsi.** [*In Chinese.*]—*Kwangsi Agric.* **6** no. 1–6 pp. 26–32, 9 refs. Liuchow, 1946. (With a Summary in English.)

Synonycha grandis, Thnb., is one of the most important natural enemies of *Oregma lanigera*, Zehnt., on sugar-cane in Kwangsi. Attempts to breed it on its natural food on a large scale for liberation against the Aphid were unsuccessful, chiefly owing to the difficulty of supplying sufficient Aphids as food, and attempts to breed it on artificial media were made in 1941. When adults of the overwintered generation were fed on 10 per cent. molasses solution alone or with egg yolk, milk powder or soy-bean flour, normal oviposition did not occur, though they lived longer than others fed on Aphids. Adults of the first generation fed on a mixture of egg yolk and molasses with the addition of a few drops of tomato juice or juice from freshly pressed Aphids did not reproduce, and larvae fed on artificial media died within a few days. There was no difficulty in rearing the Coccinellids on Aphids during the spring, though only 21 per cent. of the eggs hatched as a rule, but in summer adult mortality was high and reproduction seldom occurred. Both adults and larvae were cannibalistic, adults feeding on eggs of their own species even in the presence of plenty of normal food, and larvae killing each other when starved.

The results of liberating adults of *Synonycha* at the rate of 500 per 200 sq. yards in isolated plots of sugar-cane in November indicated that they tend to migrate. Only half of them were recovered 20 days after liberation, practically all had disappeared after two months, and although the population density of the Aphid was much reduced at the end of the experiment, there was no significant difference between colonised and untreated plots.

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La Rivers (I.). **A new Weevil Record** [*Cryptorhynchus lapathi*, L. on willow] **for Nevada (Coleoptera, Curculionidae).**—*Pan-Pacif. Ent.* **22** no. 4 p. 132. San Francisco, Calif., 1946.

Bryant (G. E.). **A new Species of *Monolepta* [*gossypiperda*] (Galerucinae, Coleoptera) from Africa feeding on Cotton** [in Southern Rhodesia].—*Ann. Mag. nat. Hist.* (11) **14** no. 116 pp. 584–586, 1 fig. London, 1948.

Siegler (E. H.). **Leaf-disk Technique for Laboratory Tests of Acaricides.**—*J. econ. Ent.* **40** no. 3 pp. 441–442, 1 fig. Menasha, Wis., 1947. (Reprint [see *R.A.E.*, A **36** 343] with the addition of a figure of the apparatus used.)

Soloway (S. B.), Schec[h]ter (M. S.) & Jones (H. A.). **Analysis of technical DDT. The chemical Evaluation of technical DDT by Dehydrochlorination.**—*Soap & sanit. Chem.* Blue Book 1946 pp. 215, 217–218, 221, 2 graphs, 16 refs. New York, N.Y., 1946.

Report of the Fifth COMMONWEALTH ENTOMOLOGICAL CONFERENCE,

22nd-30th JULY, 1948.

A detailed account of the Conference, together with the conclusions and resolutions arising from it.

A memorandum of the work of the Institute from 1935 to 1948 is given in Appendix I (pp. 14–19). The reports of the various Committees constitute Appendix II (pp. 20–26). Appendix III (pp. 27–112) consists of the proceedings of the scientific meetings, which are as follows :

Subjects	*Openers*
Recent Developments in Insecticides	R. A. E. Galley
Mode of Action of new Insecticides	V. B. Wigglesworth
Uses and Limitations of the new Insecticides in the Field	W. A. Ross
Recent Developments in Pest and Disease Control Machinery	H. G. H. Kearns G. H. Berkeley
Application of Insecticides from the Air ...	D. L. Gunn
Biological Control	A. B. Baird W. Cottier R. H. Le Pelley D. Miller
Estimation of Insect Populations in the Field	A. H. Strickland
Developments in the Control of Stored Products Insects	F. N. Ratcliffe
Tsetse Research and Control	T. A. M. Nash K. R. S. Morris
The Need for Plant Quarantine on a Continental Basis, with special Reference to Africa ...	G. F. Clay
History of the Bureau of Biological Control ...	Sir H. Howard
Locusts and Grasshoppers	B. P. Uvarov A. J. Nicholson
Discussion of Summary of Information on Termites	

The papers read by the openers are given in full, together with summaries of the discussions that ensued.

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